JOURNAL OF GAS LIGHTING, WATER SUPPLY, &c.

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EDITORIAL NOTES—GAS, &c.

The Heating Field.

FOLLOWING up our comments on the letters that have lately appeared in the "JOURNAL" on the subject of the field for gas heating, it is interesting to observe how few of our correspondents had, until their attention was particularly drawn to the matter, any conception of, or had really considered, the extent of that field, and what it would mean for the gas industry and for atmospheric purity if only a portion of the raw material that is now used for domestic heating was scientifically separated into its gaseous, solid, and liquid constituents, and the gaseous part used for heating by means of gas-fires. And has anyone in the industry any objection to even a part of the money paid for the nearly 60 million tons of coal that are, it is estimated, shot annually into the private cellars of the inhabitants of these islands passing through the gas industry's banking accounts? If not, then let us be up and doing, and not stiffen our backs against the special exertion and encouragement that are needed to get the additional business, and to displace crudity by refinement.

One correspondent denies lack of commercial enterprise on the part of gas managements in this matter of gas-fires; but from the one example of Huddersfield, we cannot judge all. Our contention is that upon gas-fires there has not generally been expended the same developing effort and enthusiasm as there has been upon (say) cookers, though of cookers one suffices for each house, but nearly every room in the house offers a possible point of utility for gaseous fuel; and that, save in perhaps a few places, the endeavours put forward have not been so comprehensive as they might have been. Nor can we altogether judge of the fitness of method to all districts, and the manner of applying the method, by what is done in one town. It is, however, Mr. Harman's opinion that a really economical gas-fire is the *desideratum* to make this heating business go. We have lately been referring to new gas-fires, the consumption of certain of which is only about 15 cubic feet per hour; and with that consumption, the efficiency is that of many a former gas-fire burning a much larger quantity of gas. There is thus much less to complain about than formerly in this respect; and if a 10-inch gas-fire is called uneconomical that consumes 15 cubic feet of gas an hour, then what, pray, would the electricity consumption per hour of a four-lamp electric radiator be called? But while Mr. Harman asks for greater economy, "D. S." is of opinion that this cutting down of consumption is a retrograde step, and that efficiency is lowered. "D. S." does not reason well. What is efficiency? It is the highest effective value that can be obtained from a given expenditure (in this case) of gas. Now if it can be said with truth that there has been no advance in gas-fires such as to increase their efficiency per unit of consumption, which increase of efficiency permits of the unit of consumption being reduced and yet realize the old heating value, then we should stay at once our endeavours to put more life into the development of the heating branch of the gas business. But fortunately our experience does not coincide with that of "D. S.;" and of this we are sure, that it is not the progress which yields economy in gas consumption that is going to disgust the class of householders who form the backbone of the gas industry's custom.

In only two or three of the letters received—notably in those by Mr. R. G. Shadbolt and Mr. Harman—was anything said as to the methods that have been applied to cultivate the heating branch of the gas business. In the case of Grantham, the methods have not yet advanced, but they are on the road, to a special price for gas used for heating and the letting of gas-fires on simple hire; while in the case of Huddersfield, a differential price does obtain, but there has not been any extensive adoption of gas-fires in the town. We are not favoured by Mr. Harman with figures to ascertain whether our interpretation of the phrase "extensive "adoption" would agree with his; and he is the best judge as to whether the 1s. 6d. charge for gas for heating has been brought with sufficient directness to the notice of the gas consumers, and whether they have been educated sufficiently regarding the advantages of gas heating. Of these things as applying to Huddersfield, we cannot speak; but in Mr. Harman's opinion, under his special circumstances, the efficacy of the differential price in promoting the heating business has not been proved. But this he will admit, that it has done it no harm. On the other hand, in Mr. Shadbolt's code of professional beliefs stands this: "I recognize in the "discount meter the most suitable means yet devised for "popularizing the gas-fire at a minimum expense." "Secre-"tary" bears this witness: "We have had the differential "system in use for a considerable time, and are well satis-"fied that the system is a thoroughly business-like one." "Commonsense," who is an official of a large Foreign Gas Company, says: "I can speak most positively as to the "benefits accruing from the system of differential prices of "gas, coupled with meters of the small rotary type, applied "to the purposes named." Again, the President of the North of England Gas Association (Mr. H. Wilkinson), in his address to the members a fortnight or so ago, testified to the advantages experienced in Harrogate of differential prices in developing the day business. From this it will be seen that experience varies in this matter of differential prices, and there must be some local or administrative reasons for the variation. They are worth inquiring into. It will be noted, however, that Mr. Harman is the only one among our correspondents who has applied the system, and found it wanting.

But there is "Radiation" who does not see much reason in supplying a gas-fire user who comes on in September and goes off in April at a cheaper rate than the twelve months' lighting consumer. We might well turn round and say that there does not appear to be much reason in supplying the short-hour lighting consumer with gas at the same price as (for six months in the year) the long-hour heating consumer. We happen to know that in the town from which "Radia-"tion" hails, the gas-fire has not made any great progress; and we know, too, that "Radiation" is not adverse to a substantial concession to the industrial gas user. Gas, in the majority of places, is in all conscience cheap enough now for lighting purposes; and if the gas heating business has not prospered in a town, why has it not done so, and what will help it forward? "Radiation" also points out that where heating gas is supplied at a less rate than for lighting, the anomaly might arise of the electric lighting consumer obtaining his gas for heating at a less price than the gas-lighting consumer his gas for lighting. There is bound to be a little over-lapping that will give scope to cavil; but from a business point of view, we should not regard it as an altogether bad stroke to get gas into the house of an electric light consumer even at a reduced price for heating purposes. The fact of the matter is that, as Mr. Shadbolt said some time ago, and has emphasized in this correspondence, the sale of gas for lighting, for heating, and for power must be regarded as separate and distinct businesses. We cannot ignore the value of our commodity to the consumer, and its relation to the values of competing commodities, for each and every purpose. If we do, then the inevitable consequence is that the gas industry will yield its place of supremacy in the competition. We have in these times to immolate what to some was the sacred flat-rate (if the flat-rate will not serve all ends) to the necessities of new conditions.

There were many other matters raised in the correspondence—such as the criticism passed on canopy and register gas-fires; the question of gas-fire fuel, and the declaration of Professor Lewes in his Institution lecture at Dublin that the radiating power of fuel can be considerably increased in a very simple manner; and the need for co-operation between the gas and architectural professions. It is clear that the gas

engineer has knowledge in his possession which it would be useful for the architect to possess; and the advance to mutual assistance must begin with the gas engineer. Such a step is already in a fair way of being taken; and we are hopeful of the best of results.

Meanwhile, would it not be possible for gas undertakings to gather experience this winter as to the application (say, on a limited scale for the time being) of a differential price for gas for heating, through the medium of a simple discount meter, circularizing well in the district chosen for the trial the advantages of heating by gas?

In the Uttermost Parts of the Earth.

In the present issue is concluded the interesting article from the pen of Mr. Chenery Suggate, of Auckland, N.Z., describing the new gas-works that he has constructed there for the Auckland Gas Company; and also in this issue is a description of the new gas-works at Bahia Blanca, in Argentina, for the design and construction of which Mr. Arthur Gibson has been responsible. We heartily welcome illustrated descriptions of works such as these, as, be it known to those gas engineers who are situated in distant parts of the earth, information as to their doings is as interesting to their *confrères* at home as is intelligence from home to them. In reading these articles, we see how largely and how far has penetrated British gas-works practice—from coal-handling and carbonizing systems to methods of ensuring that consumers are furnished with modern and efficient fittings and appliances. That these things should be, must be a source of satisfaction to those engaged in the industry at home. But just as trade follows the flag, so British practice follows British capital and labour; and British capital and labour have planted the gas business in more places abroad than can be boasted by any other country. We must not, however, over this pat ourselves too much on the back. Other countries have remarked that the investment pioneered from this country in this way has been fruitful; and they are acting upon their observation.

However, regarding gas-works construction in distant parts, the two articles on the new gas-works at Auckland and Bahia Blanca present us with many instructive points. The engineer setting about the construction of a gas-works at such a distance from home has to have his wits about him, and he has to look well to prospective needs; for plant and appliances are not his at short notice and a few hours' journey, but time is measured by weeks and months before requirements can be filled, and distances between source of supply and delivery are measured by thousands of miles. Engineers who work under such conditions must be men of resource, and their works self-contained and well in advance of all necessities. In these two cases, Mr. Suggate and Mr. Gibson respectively had virgin-soil to work upon in creating new works for those whom they were serving—the latter gentleman especially so, as in Bahia Blanca gas had not before been seen. But in both instances, it will be observed that comprehensiveness and modernity are of the lineaments of their schemes. The works at Bahia Blanca constitute a masterpiece in rapid construction from the time plans were accepted and contracts sealed; and a full-blown undertaking, replete in every respect from coal-store to office, has been left in the hands of the permanent officials. Both there and at Auckland, we see the wide-reaching favour of mechanical operation from the handling of material onwards; and we see, too, that the all-round merits of regenerative settings of horizontal retorts are favoured. Auckland, it is interesting to note, witnesses the introduction in New Zealand of the De Brouwer projector and the De Brouwer-Jenkins retort-discharger. In every other part of the plant at both places approved British types are found. Another point of interest is the complete workshop equipment, for the works have to be self-dependent in respect of the repair of both the internal and the distribution plant and appliances.

Just as plant ensuring economical operation is found in the works (the economies of the new plant at Auckland have already benefited the consumers to the extent of 3d. per 1000 cubic feet), so the consumers are keen for that which is modern, and consequently for that which is sightly and economical, for use in their houses; and therefore the showrooms are furnished in quite the mode of the more favoured ones at home. In considering the price of gas at Bahia Blanca—11s. 6d. per 1000 cubic feet—consideration must be given to situation for the purchase of material, and to the big discounts (which appeal there) offered to those using gas for cooking and motive power—respectively 30 and 40 per cent. For lighting, gas at the price named, consumed in an incandescent burner, is cheap compared with electric lighting there. And electric lighting (which was first in the field in Bahia Blanca) has prepared the way for gas being received, metaphorically speaking, with open arms. The vagaries of the light have produced disgust; and the fitters attached to the new gas undertaking are therefore busy putting reliability in the way of the people of this growing city and port. The prices obtained for residual products in Bahia Blanca would make the mouths of many gas managers at home water. We will not mention the figures; but it is a good thing for those whose enterprise has placed gas supply in that new territory that a few thousand miles separate their highly promising centre of operations from the managements of gas-works who have never in their wildest dreams contemplated handling so much hard cash as is doue there for a ton of coke or tar. Our best wishes for the success of their new works go out to the Auckland Gas Company; and we also hope for a very prosperous development of the fresh ground opened up under such auspicious circumstances at Bahia Blanca.

Distribution Troubles and Reinforced Concrete.

The members of the Midland Association of Gas Managers on Thursday last had their attention diverted, by Mr. W. C. Jones, of Brierley Hill, and Mr. M. Kahn, of London, from ordinary and current gas topics to matters of less general but unusual interest. Mr. Jones gave an impressive account of the difficulties he has to encounter in connection with his distribution system in the mining district of Brierley Hill; and to those comfortably situated in areas where their canalization remains in a fairly composed and intact state, other than the effect of disturbance and vibration occasioned by surface traffic and the ordinary subterranean work of a town, his tale of woe and of (in all modesty stated) masterful endeavour to maintain an upper hand over his distribution plant must have sounded almost like—though his hearers knew full well it was not so—a bit of romancing. But the paper was one constituted of stern fact; and it is clear that the individual who is in responsible charge of the gas supply in such a district must, in the words of Byron, be "submissive, "yet with self-possession mann'd." No gas engineer and manager not endowed with self-possession, patience, and alertness would be of the slightest use in such a position as that which Mr. Jones occupies. He has to be watchful to protect the interests of those he serves and to prevent disaster, and be always prepared for any emergency. It is the work of such managers that puts us in possession of knowledge as to what is best under like circumstances to detect mischief, and as to what is the most effective system to obviate to the utmost extent such trouble as has been experienced at Brierley Hill; and the placing on record of an account of the special work in this case will be of immense value to those who come after, or those who may find themselves beset with similar difficulty—difficulty that is enough to dispirit the most stout-hearted. Not only in all mining districts but elsewhere is such experience valuable. With present-day road burrowings and upheavals for numerous public purposes, the safety of gas distribution systems in most towns is more acutely threatened now than ever before. The stresses that mains and service-pipes and their joints have to bear have been multiplied many times; and therefore experience under the worst possible conditions, such as those at Brierley Hill and those referred to in the discussion, will not be without interest to gas engineers generally.

Mr. Jones's narrative really divides itself into two parts—viz., detection and attempted prevention. Whatever the attempts at prevention, however, it would be impossible to forego, though it might mitigate the need of, active watchfulness. But Mr. Jones has to deal with existing conditions; and nothing less than a regular inspection of the mains every morning by his men will give him any sense of security for the day. Very serviceable in this work, he finds Ansell's leak-detector; and other valuable aids are periodical tests with a test meter, and Thorp and Marsh's diagrammatic meter. In one district he has also resorted to the fixing of a 500-light meter, against the registration of which he checks the weekly readings of the consumers' meters in the locality. The paper describes the methods by which the various tests are applied; and there is such comprehensiveness about them that we fail to see how he could really improve. If there are any additional means that

other managers experienced in such districts have found useful, Mr. Jones and readers similarly circumstanced would be glad to hear of them. Where leakages are found by Mr. Jones, immediate measures are taken to effect their repair. But it is discouraging while repair is going on in one spot to hear ominous crackings in the neighbourhood, or to find on the morrow of a repair that the road has further subsided and perhaps a lamp-post or two has or have become dwarfed in the remarkable manner portrayed in one of our illustrations. But all this incessant watchfulness and care impose a considerable expense upon the gas undertaking, and turn the Manager's thoughts to prevention. If a district was going to be piped to-day for the first time, and it was known that within a measurable time the streets would be undermined as are the streets of Brierley Hill now, the piping would be of a character somewhat different from that with which Mr. Jones has to contend, though the most up-to-date system for such a district might only afford alleviation, and not be a certain cure of, or a perfect guard against, difficulty. The flexibility and elasticity of Mannesmann steel tubes, properly coated, are preferable to ordinary cast pipes for such districts; and it is interesting to learn that Mr. Jones finds that they cost rather less than the cast pipes. But it is not the first cost only in such situations that must be considered; to any real preventive credit must be given for all subsequent savings in labour and leakage. For connecting the service-pipes to these mains, a special form of clip is used; but the question of the relative merits of lead wool and molten lead for the jointing of the mains is a debateable one—Mr. Jones advocating with good case the former, while other engineers have a liking for the older method. Some engineers in Mr. Jones's position have found expansion joints of considerable value; but apparently he does not hold them in any great favour. In such matters, there are sure to be differences of opinion; but nevertheless it is a good thing to collect opinions founded on practical experience, and select those possessing most merit.

Reinforced concrete construction was the subject on which Mr. Kahn discoursed. Excepting for foundation work, such construction has not yet largely appealed to gas engineers. Even in their most recent structures, they have, with an exception or two, continued to put their faith in bricks and mortar, or in steel-framed and brick panelled buildings. The lecture of Mr. Kahn, however, will assist to remove doubt and prejudice; and we may henceforth expect to see the system adopted with greater frequency in gas-works. There are engineers who—like Mr. R. O. Paterson—cannot see that reinforced concrete has any great field in gas-works building, save perhaps for gasholder and other tanks. But, as a matter of fact, if the conditions are such that there is nothing specially in favour of brickwork or masonry, reinforced concrete work is admirably adapted for gas-works purposes. The structures are not of a complicated order. Except in retort-houses where there is overhead coal-handling machinery and hoppers, they have to carry no great weight other than is supported direct from the ground floor; and where steam and gaseous fumes, in addition to other atmospheric action, are present to assist in the work of deterioration, there of all places must a building material impregnable to all such influences be advantageous. This point of durability must be taken into account when considering the question of first cost—first cost being in itself determined by locality and availability of material, by design, and by the method of carrying out the reinforced concrete structure. On this last-named point, in much of the simple straightforward structural work required by gas-works, there is no need for any proprietary system of reinforcement; but in the larger structures the specialist in this work will make a more satisfactory job, and produce economy, where an engineer inexperienced in such work might produce failure, exceed his estimates, and bring upon himself endless worry. One of the best examples of reinforced concrete structures in gas-works in this country, is that which was described by us when dealing with the new Poole Gas-Works of the Bournemouth Gas and Water Company; and in that case Mr. Harold W. Woodall, the Engineer, informed us that by this system he saved money, and was in possession of the buildings in two-thirds of the time that brickwork would have occupied in erection. Of course, there is a point below which reinforced concrete is not economical under any conditions; and therefore judgment of such a system of structure must not be based on too limited an example. Mr. Kahn has designed a trussed bar, consisting of a main tension bar and fixed diagonals, which is the foundation of what is known as the Kahn system of reinforced concrete construction. The bar has been designed on what appear to be theoretically correct principles; and substantial and large-dimensioned buildings testify to the practical rectitude of those principles.

The Manchester Exhibition.

To-morrow the Manchester Gas Exhibition opens; and representatives of the industry from all quarters will assemble in the great industrial centre to wish success to the venture, and to congratulate those who have been working so enthusiastically in this matter of organization on what they have achieved. What they have achieved promises exceeding excellence, and unique feature. Everything has conspired to this end. It is a case of concerted willingness and energy having made a comparatively smooth path for easy running. The obstacles have been anything but great, though necessarily the details inseparable from the bringing together of so many units to make a complete organization have entailed somewhat heavy labour.

But we have never known an exhibition that can have given less anxiety than this one has to the Advisory Committee and their untiring executive and voluntary officers, who have proved themselves veritable votaries to the cause of the exhibition. Much of the ease experienced is due to the representatives of the Manchester District Institution of Gas Engineers having obtained the co-operation of the Society of British Gas Industries, and having fully recognized from the outset that the manfacturers are a body with whom to collaborate, and not a body that there should be any attempt to command. The difference between the two methods is palpable; the effect is a marked impression on result. The Manchester Corporation Gas Committee have also worked in a really co-operative spirit with the Advisory Committee, and have borne expense and volunteered concession, that have set them in a new light in the estimation of the moving spirits of the exhibition.

As to the exhibition itself, lighting, cooking, and heating will be represented and demonstrated in all their variety, attractiveness, and utility. Indoor and (in the streets leading to the exhibition) outdoor lighting will be demonstrated. Distant and automatic lighting and extinguishing will be displayed. But a great feature will be the exemplification—and most appropriately in this centre of industry—of the industrial uses of gas. Of loan exhibits there are to be many. The lectures and demonstrations will be of that popular and practical order—the lectures are in the hands of men who will handle their subjects with ability and cogency—that will appeal to all who are not of the gas industry but essential to its well-being. Senior and Junior gas organizations are being drawn to Manchester by the exhibition. As we take a last look round before the opening, nothing occurs that has been left undone to make the exhibition for those who are displaying their goods, and for the district generally, one of considerable profit.

Post of Honour for the Yorkshire Juniors.

The proceedings at the annual meeting of the Yorkshire Junior Gas Association held on Saturday—the last, but probably the most important, of the opening gatherings of these young organizations for the present session—which are reported in another column, possess special interest from the fact that they took place in the University of Leeds, and that at the close of the business the members had an opportunity of inspecting the arrangements, so far as they have been completed, in connection with the new Departments of Fuel, Metallurgy, and Mining, over which Professors Bone and Thompson will preside. Those who were able to attend had a double reward in hearing an excellent opening speech by the new President (Mr. J. H. Hill, of York), and what we think all will regard as an address of far-reaching importance by Professor Bone. He emphasized the value of a judicious union of theory and practice in professional work, and indicated the way in which he thought the new department to which he will devote his attention, and in the establishment of which Professor Smithells has had so large a share, will be helpful in effecting this union, and in the solution of problems connected with the heating properties of gas which may have great, but at present unsuspected, influence on the future of the gas industry. Professor Bone's remarks to the Yorkshire Juniors will, there is not the least doubt, be well pondered over by them; and they may prove not unprofitable reading to some who are no longer in the

class to which those to whom they were addressed temporarily belong. In the concluding proceedings, when votes of thanks were enthusiastically accorded to Professor Bone and his colleague, reference was made to the historic interest of the day—how that it was really the formal introduction to the gas industry of the first University Gas Department in the United Kingdom, and how that Professor Bone had really, in the address given, made his official *début*. The speakers voiced the Association's pride in having the three Professors' names on their roll as honorary members, and in having been, in a subordinate way, the medium of these having made some of their appeals to the industry. They felt that the new department had a meaning and an interest for them more special than for any other body of juniors; and they hoped so to help it—indirectly, perhaps—that it should have a special interest in and affection for them.

No Compliments Needed.

A considerable amount of applause, which testified that the meeting found itself in accord with the views expressed, greeted Mr. T. Hurry Riches, the President of the Institution of Mechanical Engineers, when he made a few remarks before the opening of the discussion last Friday on the paper (a notice of which appears in our columns to-day) read by Professor Bertram Hopkinson on the "Indicated Power and Mechanical Efficiency of the Gas-Engine." Briefly, what he had to say was, "No compliments are needed;" and the arguments he was able to put forward in support of this assertion, were logical and convincing. The papers which are submitted to the Institution are very frequently indeed the subject of long discussions, in which a number of speakers take part; and if each one makes a point of prefacing his speech by eulogizing the author of the paper and his work, the time taken up, small as it is in individual cases, in the aggregate reaches an appreciable amount. This it was that led the President to ask the members of the Institution, when joining in discussions, to make a departure from past practice, by dispensing in future with the purely complimentary remarks which they may feel a desire to make. In spite of all exhortation, however, this desire proved irresistible in several cases on Friday; for more than one speaker felt impelled to praise, though it had to be done in some such way as, "I am unfortunately debarred from saying all the nice things I should like to." The reasons given by the President for his suggestion were that the Council of the Institution did not accept a paper unless they considered it valuable; and that, in accepting it, they desired to compliment the author on the efficiency with which he had treated the question chosen for his paper. It was, however, not only to the complimentary allusions with which some of the members commence their remarks that the President referred; his appeal was intended to apply to complete speeches in some instances. At least, this would seem to be the case from his concluding sentence, which was: "If I may say so, we have some members who get up, and all they have to say is how very ably the authors have dealt with their subject."

High-Pressure Distribution in America.

By a rather curious coincidence, what may be called the outside work of a gas engineer—that which is concerned with the distribution of his manufactured product—receives more than usual attention in to-day's issue of the "JOURNAL;" and, strangely enough, by two gentlemen bearing the same name, but separated from each other by a wide ocean and a vast continent The paper read by Mr. W. C. Jones, of Brierley Hill, before the Midland Association last Thursday, in which he recounted the difficulties he experiences in keeping his mains intact in ground which is constantly subsiding owing to colliery workings, is dealt with elsewhere; but attention may be called here to another, which was read by Mr. E. C. Jones, of San Francisco, at the recent meeting of the Pacific Coast Gas Association. It may be in the recollection of our readers that Mr. Jones gave the members of that Association last year an interesting account of the condition of the distributing system in the city after the terrible earthquake. This time his subject was the supply of gas under high pressure to some of its southern suburbs, the rapid growth of which presented an alluring field for the introduction of this system. These towns extend, in a continuous chain, to San José, some 50 miles away. In the early days of gas lighting on the Pacific coast, there were small coal-gas works at San Mateo, 21 miles from San Francisco; and in course of time oil-gas plant was put up at Redwood City. After the usefulness of high-pressure distributing systems had been demonstrated, a pipe-line was laid from Redwood to San Mateo, a distance of rather more than eight miles, and gas supplied at pressures ranging from 10 lbs. to 30 lbs., according to requirements. This permitted the shutting down and dismantling of the works at San Mateo. A high-pressure system was also installed at Redwood City. During the early part of 1905, Palo Alto, a city located five miles south of Redwood, was piped for high-pressure mains. In the same year, the largest oil-gas plant in the world was constructed at the Martin station, in San Mateo County, and after the earthquake, which seriously damaged the Redwood works, this station was found convenient for supplying the district. The work of laying the pipe to Redwood, a distance of 23¾ miles, was begun last February and was completed in June. The line, which is a 4-inch, cost 1½ times as much as a 2-inch one would have done; but its holding capacity is more than four times, and its carrying capacity nearly six times, as great. For particulars of the work, in connection with which a new high-pressure drip-box was used, we must refer our readers to the paper. A very interesting portion of it is that in which the author deals with the effect of compression on the illuminating power of gas, as the raising to 60 lbs. of the pressure on the Palo Alto line caused a drop of 4·6 candles. To compensate for this, Mr. Jones designed a simple appliance which he called an "auto-enricher," one of which was installed at the Redwood City works, and was effectual in restoring to the gas its lost light-giving power. Altogether, the paper is a useful contribution to the literature of high-pressure gas distribution, which the author says is, like fire, "a good servant but a bad master."

The Output of Coal.

The coal resources of the United Kingdom, representing as they do such an enormous national asset, constitute a subject of general interest, which, however, is, of course, mainly centred in the bearing of the different aspects of the question upon prices. The extent to which industrial processes and private pockets are affected by dear coal is from time to time forcibly illustrated by one of those serious rises in price of which we are at present having experience; and it is naturally during such periods that the desire for information is most keenly manifested. It may thus be taken for granted that the statistics just issued (and dealt with in another part of this issue) by the Home Office regarding the output and export of coal—though they refer to the year 1906—will be carefully studied. It will be seen that the amount of coal raised last year constituted a record, which is a state of affairs to which the figures relating to immediately preceding years have fully accustomed us. The rise is from about 236 million tons in 1905 to 251 million tons; and of this gain of close upon 15 million tons, nearly 9¾ million tons left the country in the shape of coal, coke, and patent fuel, and coal shipped for the use of steamers engaged in foreign trade. Taking the exports of coal alone to other countries, however, the increase was not quite so large as this; the quantity having been 55½ million tons, as against 47½ millions in 1905, which is an increase of about 8 million tons. Deducting the total quantity which was sent out of the country in all forms—some 76¾ million tons—from the output, there was left for home consumption 174¼ million tons, or somewhere near seven-tenths of the amount raised. Worked out per head of the population, the quantity of coal left for consumption in the United Kingdom last year was 3·992 tons, which compares very favourably with previous figures; there having been only two years since 1873 (which is the earliest year to which the the table of statistics refers) in which the amount was higher—in 1899, when it was 4·051 tons per head, and in 1900, when it reached 4·075 tons. The declared value of last year's exports of coal alone was over £30,000,000. Of this £4,693,718 came from France, £4,421,988 from Italy, and £3,481,769 from Germany. The average price of coal at the pit's mouth in 1906 was 7s. per ton in England, 9s. 5d. in Wales, and 6s. 5d. in Scotland. The average price in the London market is stated in the report to have been 15s. 9d. per ton; but, of course, the average price paid by the private consumer who subsequently bought the coal which came to the London market would be a very different figure. In 1873, which was, it may be remarked, an altogether exceptional year, the average price of coal in the London market was no less than 31s. per ton.

GAS STOCK AND SHARE MARKET.

(For Stock and Share List, see p. 270.)

LAST week on the Stock Exchange was an agitated one, with its full share of troubles and anxieties. But it was also an extremely interesting week, as it witnessed the gradual emancipation of high-class British securities from the evil influences engendered by speculative struggles raging in foreign markets. The opening was bad all round. What with the American copper war, a fall in silver, the railway agitation, the weather, and one thing and another, markets in general were sensitive and flat. Tuesday at first promised no better; but things were rather more settled before the close of it. Wednesday gave about the first distinct sign of a recovery nascent in choice lines, where the welcome buyer presented himself. On Thursday, the gilt-edged division pursued their pleasant path; but other markets for the most part were a woeful contrast, with anxious eyes fixed on the Continent and America. Friday saw these last still a prey to distracting influences on Wall Street; but the gilt-edged class went on undismayed, and not even checked, by any Friday profit-snatching. Saturday was, perhaps, the best of all. Consols rose $\frac{3}{8}$; Home Rails plucked up a bit at the admirable circular of the Midland Board; and most of the rest seemed hopeful that the worst corner had been turned. The American Market remained, however, in the miserable state of its own making. In the Money Market, rates for short loans opened and closed easy, though they were a bit stiffer for awhile in between. Discount rates steadily hardened, and closed at about their highest. Business in the Gas Market was about on a level with the week before in point of volume, and values hardly varied at all. Gaslight and Coke ordinary was quite steady at identically the same figures as the preceding week—$94\frac{1}{4}$ to $95\frac{1}{4}$. The secured issues were rather more active, and equally firm. The maximum changed hands uniformly at $87\frac{1}{2}$; the preference at $105\frac{3}{4}$ and $106\frac{3}{4}$; and the debenture at from $81\frac{1}{2}$ to $82\frac{3}{4}$. South Metropolitan was less active, and was indisposed to improve upon its opening price, $120\frac{1}{2}$. Transactions ranged between this and $119\frac{3}{4}$. The debenture marked $82\frac{3}{4}$. Nothing was done in Commercials. In the Suburban and Provincial group, Brentford old was dealt in at 247 (a fall of 1 in the quotation), British at $41\frac{3}{8}$, Southampton at $109\frac{1}{2}$ and 110 (a rise of 2), Tottenham "B" at $102\frac{1}{2}$, and West Ham at $102\frac{1}{2}$ and 103. The Continental Companies were extremely inactive. Only three transactions were marked in Imperial at from $177\frac{1}{8}$ to 178, and one in the debenture at $92\frac{1}{4}$. European fully-paid was done at $22\frac{1}{2}$ and $23\frac{1}{4}$, and ditto part paid at 18. Union was not touched. Among the undertakings of the remoter world, Buenos Ayres was dealt in at $10\frac{7}{8}$ and $11\frac{1}{16}$, Monte Video at $11\frac{1}{32}$, Primitiva preference at $5\frac{3}{16}$ and $5\frac{1}{8}$, ditto debenture at 94 and $94\frac{3}{4}$, River Plate at $13\frac{3}{16}$ and $13\frac{1}{8}$, and Cape Town preference at $8\frac{7}{16}$. The ordinary shares of the latter had a further fall on the passing of the dividend. The quotation is quite nominal.

ELECTRIC LIGHTING MEMORANDA.

Sub-Meters for Radiator and Small Power Purposes—A Specification for Street Illumination—The Electrical Industry and the Price of Copper—Electricity from the Coal-Fields.

IN last week's "Memoranda," reference was made to the stimulation the electrical press is trying to give to electric heating; and incidentally there was mention of the great difference that exists between the charges for electricity used for lighting and those for electricity used for heating. While we are in favour of different uses being regarded as distinct businesses in both gas and electricity supply, we are not in favour of any one of these businesses being conducted in a manner detrimental to any of the associated businesses, such as is the case by supplying (say) radiators or small power users at one-third, a quarter, and sometimes less, the price charged to the lighting consumer. But differential prices there must be in these competitive days where a flat-rate cannot be conceded sufficiently tempting for all purposes. But differential prices, of course, bring other costs in their train. There must be either a separate service and meter for, or sub-meters at each point of use of, the low-priced electricity—just as in the case of gas. But in electricity supply, the cost of the one or the other way of giving the consumer a cheaper supply to cultivate a day business with him is a barrier, at which the consumer himself shies, and which the electricity supplier is not always willing to leap, knowing little of what he is to gain the other side. If the vendor of electricity goes to the expense of duplicate wiring and the provision of a meter, there is no certainty that the consumer for whom the money is spent will continue his tenancy of the house, and there are no means of ascertaining whether the next tenant will become a consumer. In the event of the latter declining, the capital expended would be wasted. The sub-meter system, too, is fairly expensive; for Mr. H. S. Hatfield recently told us in the columns of the "Electrician" that the cheapest full-sized reliable sub-meter costs 28s. without the expense of fixing, and that it is anything but ornamental. But this cost, if several of the meters are required in a house, would run up the expense of installing these sub-meters to a no mean amount. He also admits that electricity meters fail; and that the chances of error are increased by every additional meter fixed in connection with any one installation. But Mr. Hatfield, after telling the truth about these expenses, appears in the garb of a not altogether disinterested person; for he tells us about a miniature mercury electrolytic meter, of inconspicuous size, and wonderful accuracy, and which, he says, can be supplied at 10s. apiece, without the cost of fixing. This arrangement is apparently the electrician's reply to the discount gas-meter.

We have been interested in an editorial article in the "Electrician" on the subject of specifications for street illumination; street illumination itself being a subject that, controlled as it is by all sorts and conditions of local peculiarity, will not lend itself to specification, unless each and every situation is favoured with separate treatment. What is good and sufficient in one place is not good and sufficient in another, owing to use and environment, both being controlling factors in the amount of money that it is justifiable on the part of a local authority to spend on the lighting. Our contemporary informs all whom it may concern that "what is really required is a definite illumination in the streets, and that such illumination shall not fall below a certain minimum at a point midway between any two lamps; and therefore that the variation of illumination from maximum to minimum shall not be excessive." That is our contemporary's definition of street illumination requirement. But how "definite" illumination is to be attained with the flame and other types of electric arc lamps, and glow and metallic filament lamps, in the illuminating field—with their extremes in illuminating power—is not explained; and it would be interesting to students of this subject to be told how the ideal state is to be arrived at. Then there is the point as to "the variation of illumination from maximum to minimum not being excessive." Well, such a specification must (there is really no help for it) completely exclude the flame arc from participation in street lighting; for its maximum illumination has such a love for the standard that there is an excessive variation between the maximum and minimum illumination by it—in ordinary street lighting. Following on, our contemporary suggests that the actual minimum may be made subject to measurement; "but there is some difficulty in making satisfactory measurements of low illuminations, such as are likely to occur as minima. If illumination measurements are adopted, it will probably be better to make such measurements comparatively near to the lamp under test; the minimum illumination being deduced if required." "Near to the lamp under test!" Of course! "Near to the lamp under test" is where the flame arc and the ordinary arc lamps give most eloquent account of themselves. Going on, we read that, in any case, "a great deal of care is necessary in such measurements, because *an arc lamp is by no means a very steady source of illumination;* and therefore measurements, if not fairly numerous, might give results considerably above or below the actual time average." There is a ring of honesty about this admission that we like. And it may be suggested to our contemporary—anxious as it is to realize an approximately definite illumination in the streets, and no great variation between maximum and minimum—that the incandescent burner, with the up-to-date methods of employing it, comes as close as anything can to the specification of what is deemed requisite. The "variation from maximum to minimum is not excessive" with burners of this type; and it is a "steady source of illumination."

The electrical industry has been sorely afflicted by the high price of copper; and there is now great rejoicing over the considerably lower price. But how long will the price remain at the present quoted figure? Circumstances are favourable to a declaration that there can be about as much certainty over the copper market as there has been this year about the weather. It is plain from what is now taking place that there is a great deal of artificiality about the attributed causes for the recent price of copper; and it is also equally clear that the market is largely at the mercy of the American producers who pull the strings in any manner that pleases them. The price of copper has been up to £110 10s. per ton; but, in a very short time, it has crumbled away to £62, which is somewhere about the average for the past few years. Of this great drop, the electrical industries do not complain; on the contrary, as already said, there has been a great gladdening of hearts, for extensions of electricity supply and tramway systems with copper at a price £50 higher than the present cost cannot be so profitable as extensions made with the material at the existing figure. But a curious feature of the situation is that the much lower price has not attracted sufficient buyers of large quantities of copper to please the producers; and the American producers have been threatening, if consumers will not bite more freely, to reduce output by closing down the leading mines for a period. The outlook is not altogether a comfortable one for users of copper on the large scale; for it is clear that the late high price has not been governed so much by the law of supply and demand as by market operators. They know that copper the electricity and traction industries must have, and at almost any price; they know, too, that the annual expansion of copper consumption is about 20 per cent. greater than the average increase for metals generally. The producers will therefore for some time to come, especially during these years of considerable development in electric traction, work things very much to their own advantage. Both in electric traction and electricity supply generally, there have been some delays in the execution of work, owing to the high price of copper; but the delays have not been so many as might have been imagined would be the case. Perhaps the

reason for this is the large extent to which electric tramways and electricity supply undertakings are under the control of the local authorities, to whom money is no particular object, seeing that it is so easy to borrow by pledging the credit of the ratepayers. Let us not do an injustice. There are a few municipalities who have taken heed of the copper market in their schemes for extensions. At Sheffield, for example, the City Council lately gave the Electric Lighting Committee authorization to purchase £24,000 worth of cable "at such times as the copper market was most favourable for the purpose." The Dundee Corporation, too, recently declined tenders that were submitted for cables while the higher prices for copper were ruling; and they determined to call for new quotations under the changed conditions. However, there can be little doubt that copper is going to be the plaything for some time to come of those who mainly control the markets. Everything has fallen so nicely into their hands that to them is largely left the shaping of events.

It is not easy to see why just at the present time the "Manchester Guardian" has treated its readers to an article entitled "Electricity from the Coal-Fields," unless it be that there is in the air some idea of reviving the old propositions of generating at the coal pit and transmitting to distances instead of conveying coal for generating purposes near to the point of use. The article has the impress of an electrical expert's hand. In considering such a question as this, endless matters come into calculation; and it is impossible to dogmatically generalize, and no two cases that could be put forward would present the same conditions. But regarding the matter in a broad spirit, the balance seems to be entirely against any advantage accruing from pit generation as against coal transmission to a home station. There are the questions of capital expenditure with its perpetual interest, of maintenance of the lines, of wayleaves, rents, losses in transmission, danger, and reliability. Reliability is admitted to be one of the most important considerations in public supply. There are quite sufficient breakdowns and inconveniences with the supply of electricity generated near home without giving scope for more; and consumers will have a decided preference for bearing the ills they have at present to endure than for flying to others that they know not of.

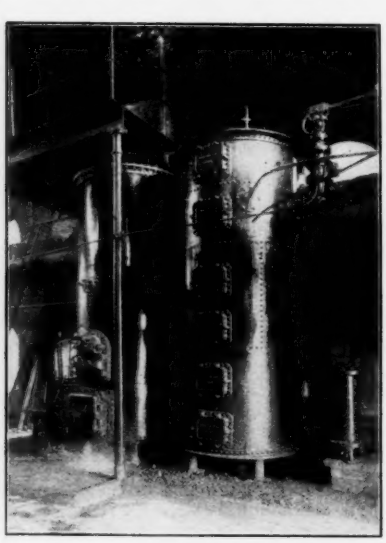
The writer of our contemporary's article wisely advises that, in the present state of knowledge and experience of long-distance transmission schemes, the risk of breakdowns or partial interruption of supply requires the most careful thought. A very high voltage would be necessary in distant transmission. In America, there is used an empirical rule for long transmissions which fixes "the voltage at 1000 per mile, with a present maximum of 60,000 volts." Even at this voltage there are considerable troubles; and what they would be like in a wet and foggy climate such as ours, no one pretends to know. It is averred that the difficulties experienced in overhead construction work have been so great as to make it much more costly than was at first anticipated, and, indeed, have rendered overhead construction little cheaper than underground cables. The writer, before concluding his article, assumes an electricity transmission scheme, from the consideration of the costs of which in relation to coal conveyance he deduces that for a load-factor of 10 per cent.—the average value in Great Britain—the increased cost would be 1·23d. per unit, and even for a load-factor of 100 per cent., which, when provision for breakdowns is allowed, is an impossibly high figure under any conditions, the increase is 0·123d. per unit, or nearly 50 per cent. more than the increased cost due to the conveyance of coal to the manufacturing town. Clearly, then, only under very special circumstances is the bulk supply of electricity from a great distance likely to be practical business.

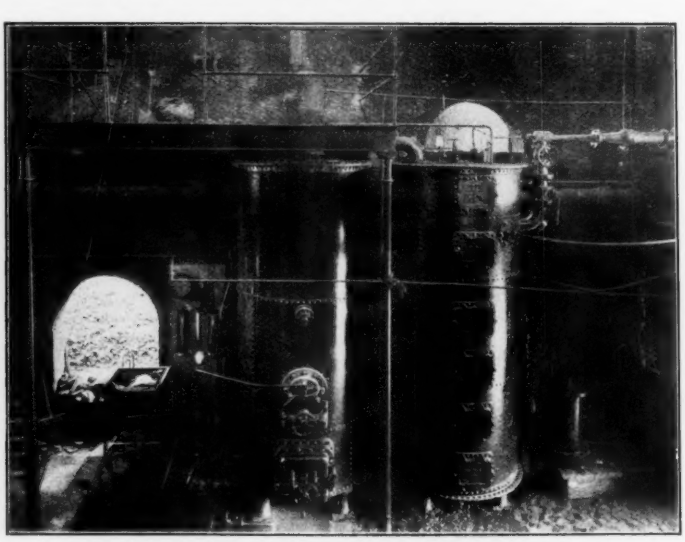
A SELF-CONTAINED METHANE-HYDROGEN PLANT FOR SMALL WORKS.

No Auxiliary Plant or Relief Holder Necessary.

It has been one of the complaints of the managements of small gas-works that they can only admire and covet from afar many of the means to economy, convenience, and efficiency in gas manufacture, and lament the fate that deprives them, who so much stand in need of all facilities for bringing down the net cost of their gas to the lowest point, of the opportunities for doing so that are accorded to larger and, in situation and other respects, more favoured works. In their carbonizing, they are denied the erection of retort-settings on a scale to produce for them the biggest yield of gas at the lowest cost, because settings of large units will not allow of that freedom in lighting up and letting down that is necessary to deal with the peak-loads of the year and with emergency demands. If such works could have an adjunct in the shape of a simple and easily-operated water-gas, or "methane-hydrogen," plant, which could be erected at a comparatively speaking small outlay, and could be used as a regular contributor to output, and for meeting their exigent requirements, or even only as a stand-by for the latter purpose, they would be placed in a position giving them greater liberty in applying the most economical coal-carbonizing plant, and in assuring them safety and relief from anxiety. Such a plant, it has been demonstrated to our satisfaction, is now at their command; and its importance will, we feel sure, be fully appreciated.

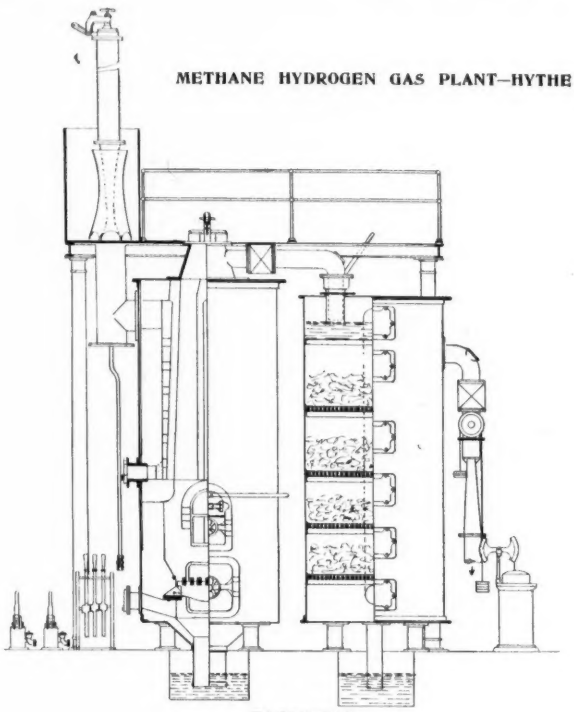
By invitation, a visit was paid to the Hythe (Kent) Gas-Works the other day; and some time was spent, in the company of the Manager (Mr. A. Reeves), in investigating a plant which is simplicity itself in construction and operation, of modest claim in regard to installation cost and space required, while in result it vies with plants of more pretentious character. It is an improved and simplified form of the methane-hydrogen plant of Messrs. Biggs, Wall, and Co.; and its capacity, under normal conditions, without working under any pressure, is 50,000 cubic feet per day. The Hythe Gas-Works only boast a present output of about 28 million cubic feet a year; and the maximum day's output is some 90,000 cubic feet. But it is within the Manager's recollection that one Christmas Eve he had registered, in the twenty-four hours, an output of 134,000 cubic feet. And he has only one holder of 70,000 cubic feet capacity, out of which he can draw 65,000 cubic feet! or a little more than two-thirds of a maximum day's output, to say nothing of the exceptional day to which allusion has been made. From these figures, it can be well understood that times of pressure and anxiety have been the portion of Mr. Reeves; but, with his new methane-hydrogen plant, he has the consolation of knowing that those times of pressure may come, but he will be able to meet them with the utmost *sang froid*. Since the plant has been in position, he has already experienced this. Last Saturday fortnight an unusual consumption ran his holder almost aground—anyway to within a couple of plates—with the evening consumption facing him. The little methane-hydrogen plant was rushed hastily into action for the first time, and saved the situation; no one in the town knowing how near they had been to deprivation of supply. Such a condition of things will not again arise with the new addition to the works guarding against all misadventure of the kind.



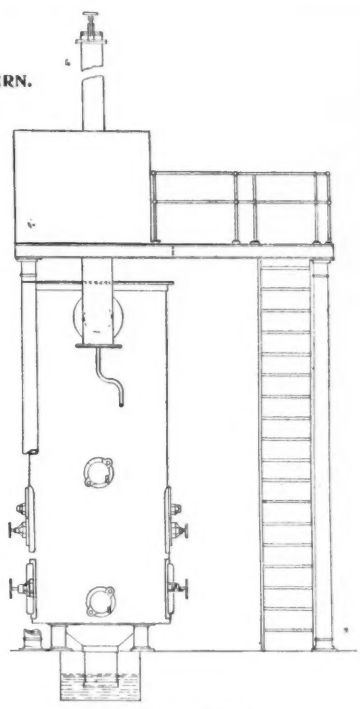


The Methane-Hydrogen Plant at Hythe.

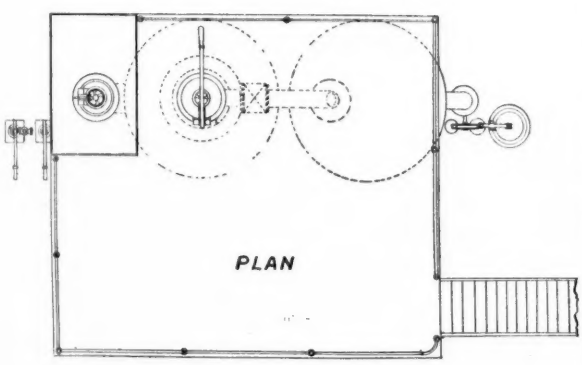
METHANE HYDROGEN GAS PLANT—HYTHE PATTERN.



ELEVATION



SIDE ELEVATION



PLAN

A Description of the Plant and Improvements.

The new methane-hydrogen plant stands in one corner of the retort-house; only occupying a space of some 18 ft. by 12 ft. It is compact, and self-contained; and beyond the plant shown in our photographic illustrations, there are no accessories—not even a relief holder. In this case the gas is mixed direct with the coal gas, and is stored with it in the one holder on the works. There are those who questioned the ability to dispense with a relief holder; but here it has been done, and without difficulty in any respect. This is an important consideration for a small works, requiring the convenience and protection of such a plant without being involved in too great a capital expenditure. Here is the plant, comprising only a very simple generator and a scrubber-washer, all within the superficial space of 18 ft. by 12 ft., with the charging-floor merely some 14 feet high, and only sufficient head-room required above for charging purposes. The stack-pipe of the generator passes through the roof of the house; and thus there is no necessity for a hood of any description.

The principles of the methane-hydrogen system are sufficiently well known; and therefore we can dispense on this occasion with their repetition—merely confining ourselves to reference to improvement in operation and, in general terms, stating the accomplishments of the plant. The generator is 5 feet diameter and 12 feet high; and the scrubber is of the same capacity. The former has the usual brick lining, and is fitted with two ∩ retorts, constituting what is practically a partitioned cylinder through the greater part of the generator. The retorts are 7 ft. 4 in. long; and the fuel bed below is only 4 ft. 6 in. deep—that is to say, in this plant, a very shallow bed of fuel is used. The advantages claimed for this shallow bed are that practically complete combustion is assured, and that there is no carbonic gas present, or combustible gases due to any residue of the tar injected into the generator. Through the clearing-out door at the part where the tar is admitted, we are able to examine the heat within; and the attendant demonstrates to us how thoroughly the heat is under control, and how easy it is for any tar remaining in the generator to be burned off, and so be prevented from going away to create a nuisance. The generator is fitted with primary-air ports (the primary air entering under the grate-bars), and secondary-air ports for admitting the air for the combustion of the gases for heating the retorts, the heat of which can be regulated at any temperature desired. The primary, secondary, and snift valves are all operated from the ground floor; on the same stand are the steam connections and valves; and alongside are the tar and benzol pumps—in fact, all the operating gear is to the operative's hand; and only the duty of charging calls him to the charging-floor above once an hour. The gases from the generator are drawn away by a steam-jet exhauster, which is also worked from the point where the levers are situated.

The Ordinary Blast Dispensed with, and Induced Draft by a Steam Jet Introduced.

We have deferred mention, in order that it might be specially dealt with, of an important innovation in this plant. It is an idea, now successfully applied, of Mr. C. B. Tully. In place of the ordinary blast, he has introduced the principle of an induced draft by means of a water-jacketted steam-jet. It was at first feared by others that the idea was an impracticable one—that the high temperature created would soon finish the career of the steam-jet. But Mr. Tully ignored those who feared, went his own way, water-jacketted the steam-jet, and scored a success. There is a constant feed to the water-jacket; and the water is used for feeding and maintaining the seal on the generator outlet-pipe to the scrubber. In this success we have a further advance in the simplification of the plant, and in reducing installation and working costs. It does away with all machinery and motive power; and among attendant advantages, it prevents the gases blowing out on to the operator when clinkering or opening the tar-doors—in fact, any necessary work can be done at any time without the slightest danger, or without interfering with the regular working of the plant. It has, in short, given an elasticity to the operation of the plant that is notable for convenience. There is one drawback to a full demonstration of what this change has effected. When fitting up a plant of this kind, it has, of course, to accommodate itself largely to its surroundings. The steam pressure available on the works is low; and the methane-hydrogen plant is only favoured with a pressure of 35 lbs. It is clear that this does not give the plant its full range with the steam-jet. With about 80 lbs. of steam, it would record a much better account of itself. But as it is, it is doing well and giving satisfaction. It should be noted that the pull of the steam-jet on the outlet of the scrubber is regulated by a compensating governor, so that a level gauge on the generator is maintained.

The Coke Used.

It has been mentioned that the operator has only to ascend to the charging-floor once an hour for charging the generator with coke; and this can be done while blowing is proceeding. A ton of coke is equal to a production of about 60,000 cubic feet of gas; and about ¾ cwt. of coke is put in each time of charging. We may say here, too, that the plant is operated in six-minute runs; about 450 cubic feet of gas being the production per run. The stand-by fuel is very low.

A New Method of Applying Tar in the Generator.

The use of tar in the generator is an essential feature of the methane-hydrogen system; and its purpose has been the subject of explanation on previous occasions. In this plant, however, there has been an important change in the method of application.

Previously, the tar was injected against the solid fuel; but looking through the tar-door on either side of the generator at Hythe, one can readily appreciate the alteration in method that has been effected, by which alteration the tar is fed through a pocket into the hot zone of the generator. Where the tar is injected, there is quite a considerable open, heated space. This has been obtained by building on the opposite sides of the generator (by the tar-doors) an arch about 12 inches in diameter, and projecting into the generator about 9 inches; and into the space so formed, the tar is injected—alternately, in succeeding runs, on either side of the generator. The tar does not now pitch up; and so there is no trouble with tar clinker. About twice as much tar can be put into the generator as before; and that is owing entirely to the provision of these tar pockets and to improved tar-injectors. Regarding the latter, at one time there was trouble through the blocking-up of the injectors. This trouble has been overcome. The tar-injector is now fitted with a piston, spring, and needle; and with every stroke of the hand tar-pump (this being the method of injecting the tar) the needle pricks out the hole in the injector nozzle, and so keeps it clean. The new injector cannot possibly block up. At the present time, about 1½ gallons of tar are being used per 1000 cubic feet of gas made; and, under normal working, the tar will be introduced at about 60 lbs. pressure.

Benzol Enrichment without a Carburettor.

Originally, more by accident than design, a new method of applying the benzol has been adopted in this plant; and experience has caused its acceptance as the right and proper way of enriching the methane-hydrogen gas. Gas was suddenly wanted; but provision had not at the time been made for carburetting the gas. Necessity is the mother of invention; and Mr. Tully determined to introduce the benzol into the top of the generator on to the black coke, and allow the hot gases to vaporize the benzol and take up their enrichment from it while passing to the scrubber. The trial was made; it succeeded; and now there is in this plant no carburettor at all. It might have been expected that, by this method of benzolizing, there would have been losses. But no losses have been found. On the contrary, there is economy in the method, because only the gas that is being made by the plant is enriched, and there is the saving of the steam used in the carburettor under the old method of working. There is an equal enrichment of the gas; and Mr. Tully is confident that this is the correct method. The benzol is pumped up to the top of the generator; and through a sight-feed, or by the number of strokes of the pump, the operator can adjust his use of benzol to any instruction prompted by the character of gas required. Less than a pint of benzol is used per run; or about a quart per 1000 cubic feet. From a pipe adjoining the plant a jet of gas was seen burning; and there could be no question it was of the 14-candle power that it was reputed to be. With the full control to which the operations of the plant are subjected, the range of illuminating value is within the discretion of the management.

Labour.

One man is far from being hard-pressed in looking after this plant. With six-minute runs, charging the generator only once an hour, and clinkering—and this is not a matter of difficulty—only once in twelve hours, he has time on his hands. But for works that could find use for a larger plant, twin generators could be installed, so as to produce a continuous flow of methane-hydrogen gas. One man could look after the two generators; and another advantage would be that one generator could be let down for repairs while the other one was at work.

The Cleanliness of the Gas.

That the methane-hydrogen gas is a clean gas is seen by the condition of the scrubber water in the tank outside the house. It contains no lamp-black from the tar; for if there is any such substance, it is filtered out at the top of the generator—in fact, the gas is given a good washing, but the condition of the water is such that it is pumped over and over again and passed through the scrubber.

The Disposal of the Gas.

As has been remarked, the plant is self-contained, and there is nothing beyond its generating and scrubbing parts but what is common to every gas-works. Mainly, the gas is introduced into the ordinary gas-works system at the outlet of the exhauster. But, in addition, a 3-inch pipe, on which is a compensating governor, connects up the methane-hydrogen main with the retort-house foul main. But this only comes into operation when the coal gas exhauster is running too fast, and so excessive exhausting is stopped, and the gases are well mixed.

Concluding Notes.

To sum up, we have here an improved methane-hydrogen plant suitable for works of small size, the managements of which have looked at the possession of such an auxiliary to their working as being beyond their means and profitable use. Let it be remembered that at Hythe the annual consumption is only about 28 million cubic feet; but the management has now this plant and with it relief from anxiety. Its installation, too, has deferred the need for capital expenditure on a new holder.

Looking at the plant generally, its great charm is its simplicity; and its new features are: The application of an induced draft by a steam-jet instead of the ordinary blast with its necessity for a fan and motive power; the methods of dealing with the tar and benzol; and no plant (not even a relief holder) required other than the generator, scrubber, and a compensating governor. The plant is compact; its construction is above criticism; we see no loophole for anything but complete working control; and being able to clean out and charge while operating, ensures that no time is lost. As we have said, there is an elasticity about the plant that is good and advantageous. When the holder ran low on the Saturday that will be memorable for the Manager, the new plant rendered its first excellent service. About 75 per cent. of the gas that was sent out on the occasion was methane hydrogen gas; but since then the distributed gas has been 50 per cent. of each, at which proportion it is intended, as near as possible, to maintain the supply. Mr. Reeves testifies that, if anything, the incandescent lights in the town have now a more brilliant appearance than hitherto; and he has not had the slightest complaint of any ill-behaviour of gas-fires or cooking-stoves during the period of regular working with the plant.

We are of opinion that this new type of plant for small works will not court in vain the attention of the gas profession, and so thinks Professor Vivian B. Lewes, who (after a visit to the plant a few days since) sent to Mr. Tully a very interesting letter, permission to publish which has been granted. Professor Lewes writes:

> I look upon the plant you have now erected at Hythe as being the perfecting of the ideas I have so long advocated, and for which I secured your able co-operation at Sligo many years ago. In saying this, I want it to be clearly understood that the whole credit is yours. The ideas I know to be theoretically correct; the mechanical skill and labour of surmounting what appeared to me and others to be almost insurmountable difficulties, has been entirely your work.
>
> The small generator you erected at Sligo, showed the possibilities which the plant at Truro and its subsequent working confirmed. You made another step forward in the excellent installation at Swindon; while the Hythe plant fulfils the dream of making a generator that will do away with all the objections of carburetted water gas (fluctuating price of oil, and excess of carbon monoxide), and yet can be made of such sizes and such low prices as to be available in even the smallest gas-works in the kingdom, and to give relief where it is most wanted—to the small working gas engineer.
>
> The gas made in your generator, while equalling in volume the best water-gas practice, yet contains sufficient methane to develop the illuminating value of any enricher added to it; so that the minimum amount of benzol can be used in attaining any desired candle power, while the coke and tar used for its production are under the control of the gas manager, who is rendered free from the worry of an outside market.

In a final paragraph, Professor Lewes expressed the hope that the recipient of his communication would meet with the success he deserves with the new generator; and we repeat that hope.

PERSONAL.

Last Saturday, Mr. Maurice Graham, Assoc.M.Inst.C.E., left England for Egypt, accompanied by his wife and child. Mr. Graham intends going from Egypt to India, then to Australia, China, Japan, the United States, and Canada, and so completing a journey round the world—expecting to return to England about the end of October next year.

We are pleased to learn that the Town Council of Amsterdam have unanimously appointed Heer J. van Rossum du Chattel General Director of the Gas Department, in succession to the late Heer van der Horst. The extent of the undertaking which will be under the new Director's supervision may be gauged from the fact that the two existing works produce nearly 2614 million cubic feet per annum, and that new works are about to be erected which are expected to be ready in two years.

The First Treatment of Ammoniacal Liquor at Dover.—In the notice of the death of Alderman Alexander Bottle (one of the Directors of the Dover Gas Company), which appeared in the "Journal" last week, it was stated that "it was due to his efforts that the Gas Company commenced treating their tar and ammoniacal liquor for the market, instead of throwing them into the sea and being fined for creating a nuisance;" and it was added that "at that time the price of gas was 12s. per 1000 cubic feet." Mr. R. Hesketh Jones informs us that this is not correct. He says Mr. George Anderson commenced treating the liquor in 1855, at which time the price of gas was not 12s., and Mr. Bottle had then no connection with the Company.

The Chemical Trade Directory.—We have received from Messrs. Davis Bros., of No. 265, Strand, the third edition of the above-named work. The book first appeared in 1899, and the contents have undergone the revision called for by changes which have since occurred. There are nearly 250 new names in the present edition; and the work has been compressed in form so as to give the increased information in less space than before. The "Directory" contains a list of the chemical manufacturers, merchants, brokers and agents, and makers of chemical plant in Great Britain and Ireland, and is therefore of special value to all who are in any way interested in the chemical and allied industries. The price of the book is 10s.

CITY OF BAHIA BLANCA (ARGENTINE REPUBLIC) NEW GAS-WORKS.

THE phenomenal progress of the Argentine Republic during the last few years has produced the natural effect on capitalists in turning their attention to this most fertile country—undoubtedly the leading food-producing centre of the epoch. Land that could be bought for a song a short time ago is now being cultivated, and live stock is being improved and refined to the standard of the "States" and this country, as can be seen by the enormous prices paid by Argentines at the Royal Show each year for pedigree animals.

This progress has been thoroughly taken into account by the Great Southern and Pacific Railways (both British undertakings), who have seen the natural advantages that a deep-sea port would offer to the enormous fertile zone at the south of the Province of Buenos Ayres, some 450 miles away from the capital, and sufficiently distant not to be absorbed by it. This port is Bahia Blanca, where vessels at high-tide may enter and go out in 30 feet of water, while the port of Buenos Ayres can only give 23 feet, and Rosario 17 feet.

It will thus be seen that the larger boats, without demurrage, can work more economically than the less-draughted vessels; so the two great railways above mentioned are pushing on with great dock and mole extensions, with grain elevators, silos, &c., to cope with the ever-increasing tonnage from the great southern and western zones. But the Great Western Railway of Buenos Ayres and a new French Railway are also seeking an outlet at Bahia Blanca.

The joint railways are carrying on a great water scheme, bringing sweet water from mountains 50 miles distant, to supply the city; and the Pacific Railway Company have undertaken to supply electric light, and have built what was supposed to be the most up-to-date plant in the world—with turbine engines, cooling tower, and underground cables, &c. But, unfortunately, the realization of the working has proved most disastrous. The blades of the turbines have become stripped. The light is thus most unreliable, often going out each night for as long as an hour at a time, causing great dissatisfaction to the inhabitants. As no modern city can possibly be complete without gas, the Directors of the Buenos Ayres New Gas Company wisely saw a great opportunity for establishing a gas-works there; and on the recommendation of their Secretary, Mr. J. M. Macmorran, who specially visited Bahia Blanca, they decided to secure a concession and build the works. Mr. P. L. G. Bridger, now the Manager, and the Engineer of the Buenos Ayres New Gas Company, went down to survey the site, and subsequently suitable land was purchased. In this arrangement, they were aided by Mr. C. D. Macdonald, the Manager of the now Anglo South American Bank.

The Construction Syndicate employed Mr. Arthur Gibson to prepare the detail and working plans, and to go out and represent them in the erection and installation of the works. These are situated half way between the city and the port—2½ miles from each—on good dry land and in a most suitable position to cope with the supply of the rapidly-extending city. The present population of the city is about 30,000, and that of the port 10,000; the latter chiefly workmen and labourers. At present, some 8000 houses in the city and 1000 at the port are available for gas; and these will increase as the city grows, which is at a very rapid rate indeed. It is calculated that, in a few years' time, Bahia Blanca will be larger than Rosario, and in about 25 years will compare in size and importance with the capital. Thus it will be seen that the future prospects of the recently-formed Bahia Blanca Gas Company are most promising.

The Company possess four squares of land of about 4½ acres each (on one of which the works are built), and which will suffice for twenty years to come. This land, purchased about two years ago, has tripled in value; and as the city and port join together, it can reasonably be assumed that the surplus land will pay for the construction of the works. In addition to this property, the Company have purchased a valuable site in the centre of the city, on which they have already erected the offices, show-room, and workshops—all to the designs, and under the superintendence, of Mr. Gibson.

Main Entrance to the Works.

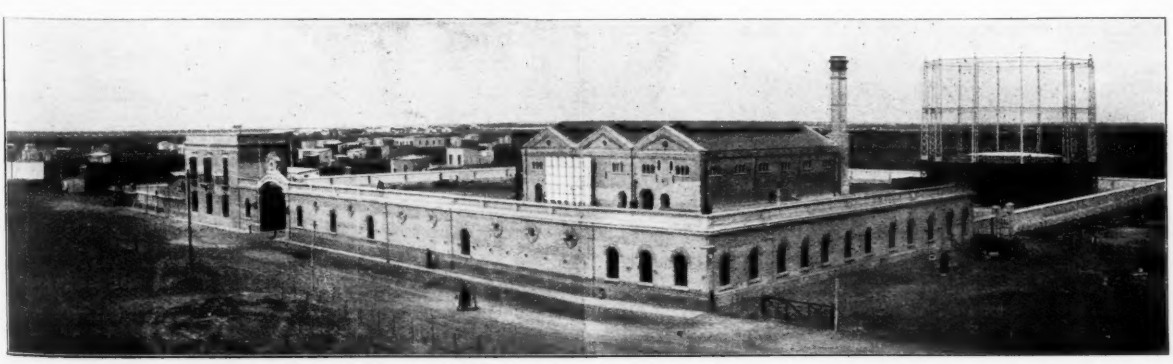
Owing to the failure of the electric light, when Mr. Gibson left on the 6th ult., there were twenty gas-fitters engaged "working full swing," putting in installations, services, meters, &c.

All the fittings are of the most modern and up-to-date class to be obtained. A great demand is being made for gas engines, cookers, heaters, radiators, &c., and everything points to the Company proving a great success. The price for the sale of gas has been based on the prices then ruling in Buenos Ayres—viz., 24 cts. per metre, or 11s. 6d. per 1000 cubic feet, with 30 per cent. discount for cookers, and 40 per cent. discount for motors. Coke and other residuals are fetching very high prices. With their modern plant employed, it is reasonably conjectured the business will eventually be very profitable.

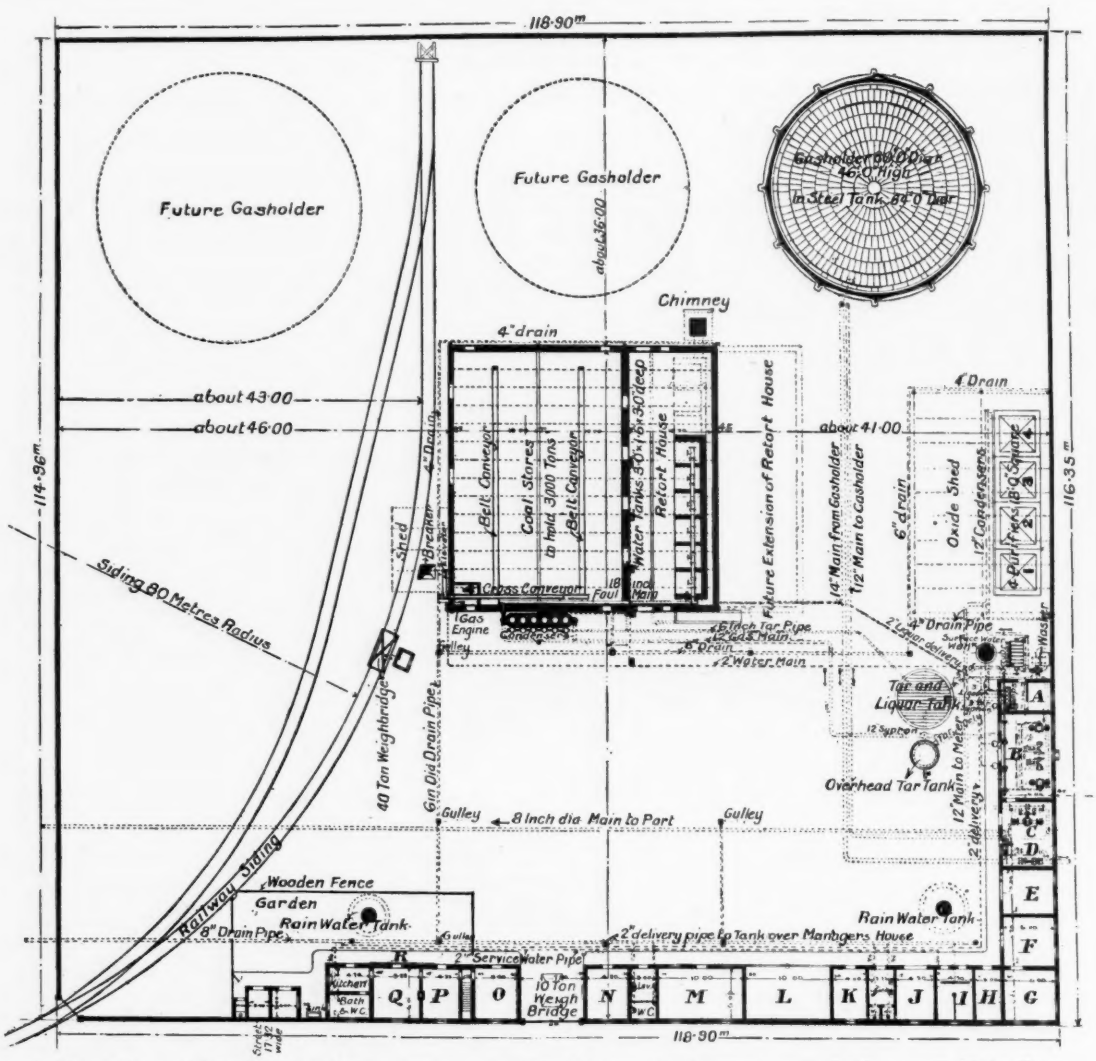
Referring to the construction of the works, we think that Mr. Gibson is entitled to sincere congratulations on the speedy manner in which they were completed. Of course, a great deal of this can be accounted for by his previous experience in gas-works building in Argentina, which dates back exactly twenty years, when he went out representing the firm of Messrs. Newton, Chambers, and Co. (with whom he was apprenticed) to superintend the erection of the plant of the La Plata Gas-Works, under the late Mr. G. E. Stevenson, M.Inst.C.E. Following up this, he erected the plant of the River Plate Gas-Works in Buenos Ayres—the foremost and finest gas-works in South America, now under the engineership of Mr. J. M. Rowbotham, M.Inst.C.E., with whom Mr. Gibson has been most pleasantly associated during the many sojourns he has made in the Argentine Republic.

THE WORKS DESCRIBED.

The gas-works, as before stated, occupy a square of land of about 4½ acres; three other squares having been acquired by the Company for future extensions or such other purpose as they determine. They are designed to produce 60 million cubic feet per annum. The design of the buildings is a mixture of Italian and English, which combination, as seen from the railway, gives quite a splendid appearance. The Manager's house and the front block of the buildings have flat tiled roofs, and the retort-



General View of the Works.



A. Photometer. B. Engine and Exhauster House. C. Rotary Meter. D. Governor. E. Smithy. F. Fitting Shop.
G. Stoves and Meters. H. Paint. I. Stables. J. Coach-House. K. Stokers' Mess. L. Shed. M. Stores.
N. General Office. O. Engineer's Office P. Parlour. Q. Dining Room. R. Gas Manager's House.

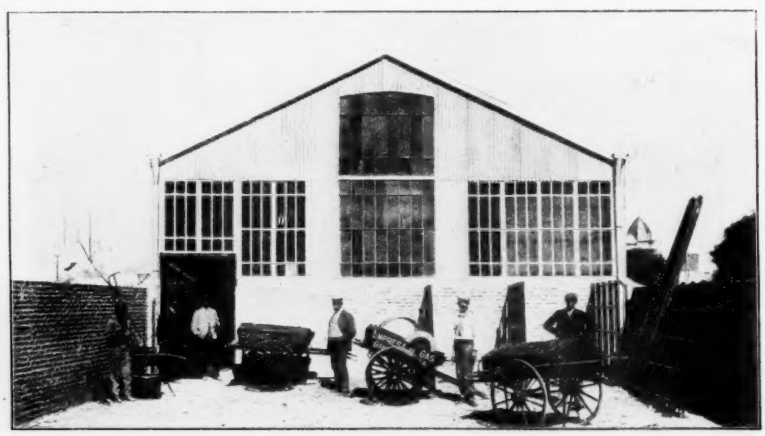
Plan of the Bahia-Blanca Gas-Works.

house and coal-stores pitched roofs with blue slates. The main entrance is surmounted by a segmental arch, carrying a clock, which is seen from both sides, and illuminated at night.

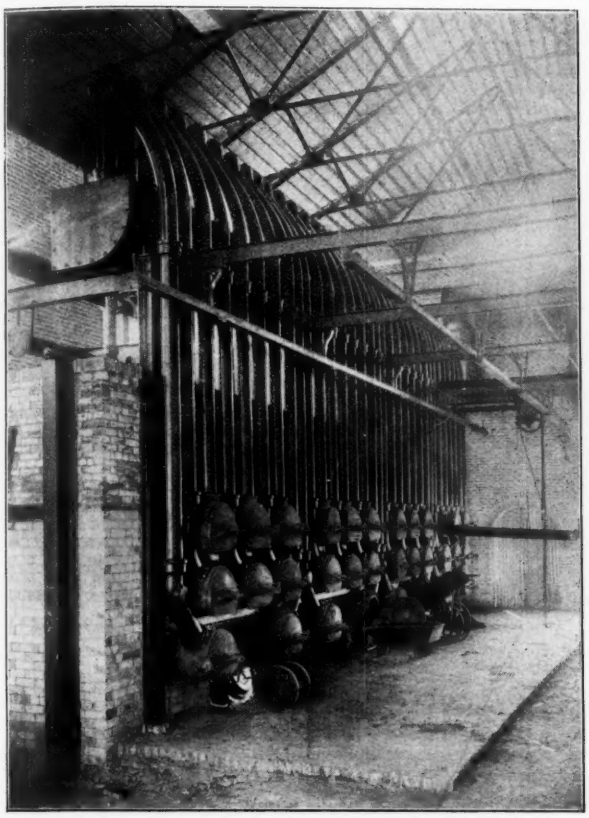
A 10-ton Avery weighing machine is fixed there also, which weighs and prints the weight of all goods entering or leaving the works. The Engineer's office is one side and the general office the other. From the Engineer's office, a view may be obtained of the whole works—nothing can be done unobserved.

The Engineer's house, of two storeys, is at the left-hand side of the entrance; and the stores, lavatories, workmen's messroom, stables, coal-house, and workshops, are on the right-hand wing, followed by the meter and governor house, the exhauster house, photometer room, and pump house. Outside follow a combined "bubble" and Livesey washer, by Mr. James Wright; then a Holmes rotary scrubber; and next a set of four 18 feet square luteless purifiers, fitted with Milbourne patent valves, doing away with connections. Following, in the corner of the square, is erected a handsome two-lift gasholder of 250,000 cubic feet capacity in steel tank 84 feet diameter by 24 ft. 6 in. deep, of great strength and thickness, to withstand the salty water found in the subsoil. There are also a tar and liquor tank, 20 feet in diameter by 10 feet deep, and an overhead tar, liquor, and water tank.

After crossing the weighbridge, the carts conveying coal pass over a well-paved yard to the breaker pit, where they discharge —the railway siding shown on the plan not having yet been put



Central Works Shops.



The Retort-Bench.

in. From there the coal is hoisted by an endless tip-bucket elevator on to a push-plate cross conveyor that delivers in turn on two longitudinal cotton-belt conveyors, which distribute the coal at any point of the coal-store. This is 31 metres long by 20 metres wide, covered by a strong steel roof and imported blue Bangor slates, as is also the retort-house, which is in the same block, 31 metres long by 10·50 metres wide. The whole of the ironwork and machinery for these houses was successfully carried out by Messrs. Drakes Limited, of Halifax. The plant is worked by a "National" gas-engine of 30 B.H.P.; the meter being by Messrs. Alder and Mackay, of Edinburgh. The coal-store has a capacity of 3000 tons, or the cargo of an entire steamer; and the retort-house is designed for nine beds of eight retorts, each 22 in. by 16 in. by 9 ft. 6 in. long, on the regenerator principle. Four beds only have been erected at present; but it is reasonably supposed that the remaining five will be required after the next winter's work. The settings adopted are upon Drakes' patent tubular regenerative system, which have given very good results in the Argentine.

The arch-pipes are of the "Bournemouth" type, and the hydraulic mains, which are made exceptionally large, are fitted with the "Farnham" system of anti-choke arrangement invented by Mr. S. J. Symonds, which absolutely prevents pitching-up and choking of arch pipes, and naturally gives a greater yield of gas per ton—in some cases, it is said, up to 1000 cubic feet.

A neat arrangement of tar-seal is also fixed at the retort-house door, so that the thickness of tar (hence the heats) can be judged at a glance.

The gas passes from the retorts in a steel foul-main around the house to a set of six annular condensers, 42-inch diameter outer and 30-inch diameter inner tubes by 20 feet high, placed at the end of the coal-store and in front of the main entrance.

From there the gas is extracted by two sets of Messrs. George Waller and Sons' three-blade exhausters of 20,000 cubic feet capacity per hour. These are driven by duplicate Crossley gas-engines of 6 B.H.P. each.

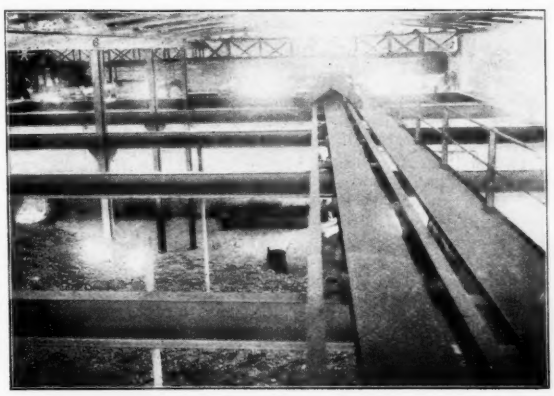
A battery of 4-inch by 10-inch stroke pumps (also supplied by Messrs. Waller), and worked by a direct-coupled gas-engine, deal with all the tar, liquor, and water on the works.

Wright's washer effectively takes out of the gas the tar in suspension and tar-fog—thus relieving, and giving greater capacity to, the Holmes scrubber; and, by certain judicious treatment of the washer, it is possible to extract the naphthalene and a great amount of the carbonic oxide from the gas.

The gas is then forced through the purifiers, which are charged with bog oxide on three tiers of grids; from there it passes to the station meter, which is of the "Rotary" type by Messrs. Marsh and Thorp, of Manchester; and thence to the gasholder erected by Messrs. C. & W. Walker, of Donnington.

The pressure of the gas is then regulated by two of Messrs. J. & J. Braddock's equilibrium governors—a 14-inch for the city and an 8-inch for the port section. This latter needs slightly more pressure, as the port district is some 20 metres lower than the city section.

The pressure gauges are by Messrs. Waller, and the photometer, chemical apparatus, and meter-testing plant by Messrs. W. Sugg and Co., of Westminster. The retort-charging apparatus is by Messrs. Biggs, Wall, and Co.; and the tools by Messrs. Nicholson and West, of Halifax. The street mains and specials are of the best Scotch iron, vertically cast in dry sand and of second fusion. Their size is 12-inch in the works, 14-inch from the gasholder to the outside of the works, a 12-inch trunk-main to the city, and an 8-inch trunk-main to the port—these branching off into 6-inch and 4-inch street mains.



Coal-Handling Plant in the Coal-Store.

Details of Roof of Retort-House and Coal-Store.

Mr. Gibson has been fortunate in meeting with very excellent and steady foremen, who have given their whole energy in helping him to complete the works in such quick time. These are Mr. A. M. Hunter, for Messrs. Drakes, Mr. J. Hurley, for Messrs. C. & W. Walker, Mr. George Parsons, foreman of mainlayers, and Mr. T. Morris, foreman over the gas-fitting department.

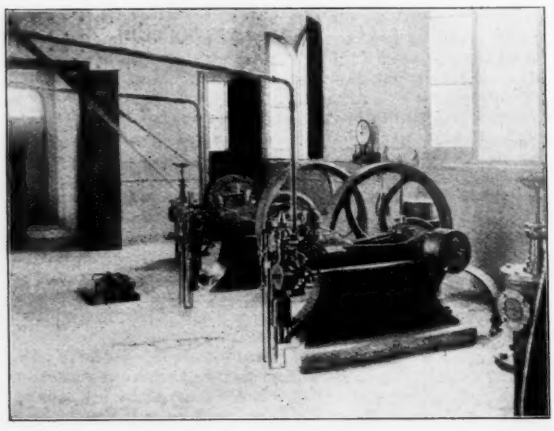
The city show-rooms are fitted up with the most modern lamps, pendants, brackets, cookers, heaters, stoves, &c., procurable on the market. The very latest system of high-pressure lighting by Messrs. Sugg is installed with cookers from Solothurn and Messrs. Richmond and Co., bath geysers by Messrs. Fletcher, Russell, and Co., self-intensifying lamps by Messrs. Moffat, the Crown Lamp Company, the Khoma Lamp Company, &c.

The accompanying views will give a good idea of the importance of the undertaking.

Before leaving, Mr. Gibson handed over the management of the Company to Mr. P. L. G. Bridger, who for a long time has held an important position with the Buenos Ayres New Gas Company, and was ultimately the Manager of the South Barracas Gas Company. The works were left under the charge of Mr. A. M. Hunter, a gentleman with youth on his side, and one who (besides being an accomplished mechanic) has a thorough knowledge of gas-making, and what a ton of coal ought to yield.

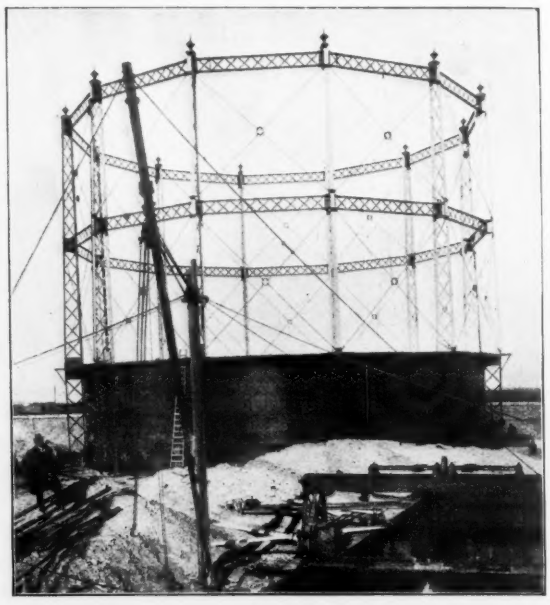
The whole of the heart of the city has been laid

with mains, and the laying to the port is being completed. But as the city is growing so fast, it will be a long time, if ever, when one may say that this part of the business is completed.

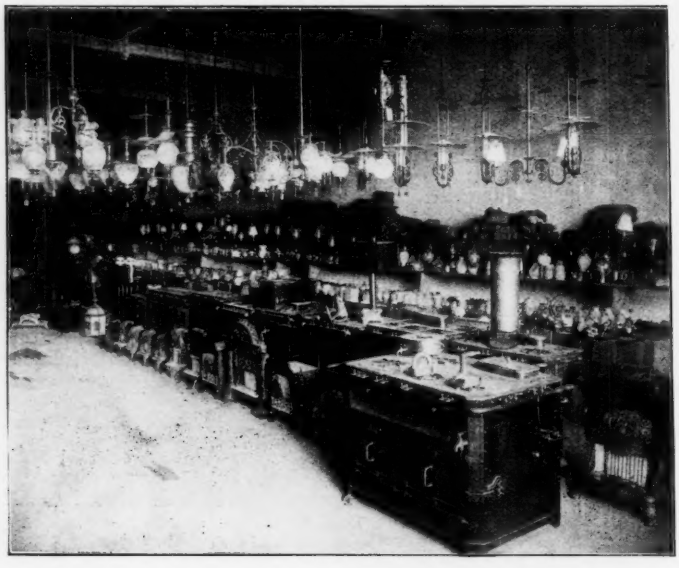


Engines and Exhauster.

Light for light, there, it is calculated that gas comes out at one-third of the cost of the electric light; and as the latter has been behaving so badly lately, gas has got a favourable start,



Gasholder during Construction.



Show-Room in the City.

and orders for lighting, power, and heating are coming in from all sides.

The capital of the new Company has been arranged to admit of making further extensions; but with the expenditure of only a moderate sum, the works can be easily doubled in capacity, and this without extending the buildings.

Owing to strikes, in which the bricklayers and labourers gained a 25 per cent. increase of wages and eight hours work per day, the buildings have cost fully 10 per cent. more than was estimated; but the Company were fortunate in accepting the tender of Mr. Antonio Gerardi, the foremost contractor in Bahia Blanca, who displayed unwonted zeal and activity in pushing the works ahead in accordance with the Engieeer's desires, and no doubt to the lasting benefit of the Company. The works are most solidly built, and nothing but the best of material has been used. They are a flattering tribute to the Company, the Engineer, and the city which is adorned by and possesses them.

A cast-brass plate, 3 feet diameter, bearing the names "Jorge Moore, Intendente; Arturo Gibson, Arquitecto; and Antonio Gerardi, Constructor," with date, was placed by the Communal Authorities on the front wall of the retort-house facing the entrance, at the official opening of the works on Aug. 25.

Scottish Junior Gas Association, Eastern District.

The members of the Eastern District of the Scottish Junior Gas Association, to the number of between thirty and forty, paid a visit last Saturday to Boghead Colliery, Bathgate, belonging to Messrs. Gavin Paul and Sons, Limited. The party travelled from Edinburgh by train at two o'clock, and on arriving at Bathgate walked to the colliery, about a mile distant. They were received by Mr. Menzies, the Commercial Manager, Mr. Hamilton, the Mining Manager, and Mr. Stewart, the Surveyor. At the pit-head they were shown the process of screening the coal, and the hand-picking. Then, descending the pit, which is 901 feet deep, they were conducted to the working face, and there saw the method of getting coal. The pit yields Boghead cannel, one of the richest of gas coals (which is largely shipped to South America), common coal, and ironstone. On returning to the surface, the party were shown the process of smelting the ironstone, as carried on by the Company; and thereafter they were entertained to tea in the Royal Hotel, Bathgate. At the conclusion of the repast, Mr. D. Bisset, of Granton, the President, conveyed the thanks of the visitors to the Company, for the privilege of seeing how gas and other coal was got, and to the gentlemen who had shown them round for the kindness and attention they had given them. Mr. Menzies and Mr. Hamilton briefly replied, expressing the pleasure they had had in receiving the company. The syllabus for the session has been issued by Mr. John R. Moyes, the Hon. Secretary. It shows the engagements which are yet to be overtaken to be: Meetings for the reading of papers and discussions, on Nov. 16, Jan. 18, and March 1; and visits, on Dec. 14 to the Corporation Gas-Works at Perth, on Feb. 1 to Messrs. R. & A. Main's Gothic Works at Falkirk, and on April 5 to the Corporation Gas-Works at North Berwick.

M. Sainte-Claire Deville's Tests of Gas.

With reference to the bracketed remarks by Mr. W. J. A. Butterfield, in the portion of his translation of M. Sainte-Claire Deville's communication to the Photometrical Congress (recently held at Zurich) appearing in the second column on p. 173 of the last number of the "JOURNAL"—to the effect that the author did not state the conditions under which the cubic metre of gas had been taken—M. Deville writes to explain that his figures relating to the calorific power of gas always represent the quantity of heat (vaporized water) produced by the combustion of 1 cubic metre of gas at the pressure of 760 mm. and at the temperature of 10° C. He points out that this is specified in the tables on pp. 66 *et seq.* of the original pamphlet, and in the second line of the table on p. 830 of the "JOURNAL" for Sept. 24; but he says he neglected to indicate it again in the conclusions formulated on p. 107 of the pamphlet.

Natural Gas in Canada.—A Special Commissioner of the "Dundee Advertiser," writing in that journal of experiences in Canada, says of a town in South Saskatchewan, known as Medicine Hat, that it is a typical ranching town, and adds: "A typical feature of Medicine Hat is that it is blessed with such a plentiful supply of natural gas that the street-lamps are kept lit all day, because it is cheaper to keep them burning than to employ men to light them and put them out. I should think that Medicine Hat has about the cheapest gas in the world. It costs 6d. per 1000 cubic feet for domestic, and 2½d. for manufacturing purposes. I suppose it will be a revelation to some of my readers to learn that a prairie town is supplied with gas, and at next to nothing, too; but, as I have already said, nothing need surprise one where Canada is concerned."

COMPLETE NEW GAS-WORKS FOR AUCKLAND, NEW ZEALAND,

TO MANUFACTURE TWO MILLION CUBIC FEET PER DAY.

By Chenery Suggate, Assoc.M.Inst.C.E., Engineer and Manager.

(*Concluded from p.* 172.)

Stoking Machinery.—We have the first installation of this class of plant in Australasia. The projector and discharger contain all the latest improvements. The charging machinery consists of a De Brouwer patent coal-projector [see fig. 5, *ante*, p. 172] mounted on a travelling carriage fitted with electrical propelling and hoisting gear, and arranged to run on rails on the stage-floor. The belt is 15 inches wide, running round three pullies, and driven by the one nearest the front of the machine.

The projector motor is of the standard steel-clad shunt-wound variable-speed type of 4 B.H.P. off a 220-volt circuit. The projector is carried by means of two pivots fitted into a wrought-iron frame, allowing the projector to be tilted at any angle. The machine is propelled by a compound-wound motor of 6¾ H.P. Both motors are enclosed, and provided with dirt-proof covers. The machine attendant can traverse the machine in either direction, raise or lower the projector, and accelerate the speed of the projector, without moving from the front platform. On the top of the machine is placed a measuring chamber, which is not altogether satisfactory, as a charge of rough coal will not weigh the same as one of fine coal.

The discharging machine is of the "Jenkins De Brouwer" patent, with telescopic ram carried in steel framework, travelling along the retort-house on the same rails as the charging machine. The propelling motor of the discharger is also 6¾ B.H.P., while the pusher motor is of 7½ B.H.P. Both are in dust-proof cases, similar to those of the charging machine.

The telescopic ram is in three sections. The first length is formed of a strong cast-steel rack and plate end. The plate end carries a hood on the top, and keeps it from crushing up the coke. Near the top of each machine are two trolley poles, each to make contact with one of the overhead conductors. The current is laid from these poles down the main angles of the frame; the conductors being properly insulated. Cables then pass to the switch and connecting box, formed of steel plates—the cables taking to one or other of the poles of the double-pole switch; the latter having proper contact charge and discharge resistances. From the switch, one of the cables is taken to a "positive" distributing board, the other to one pole of an auto-

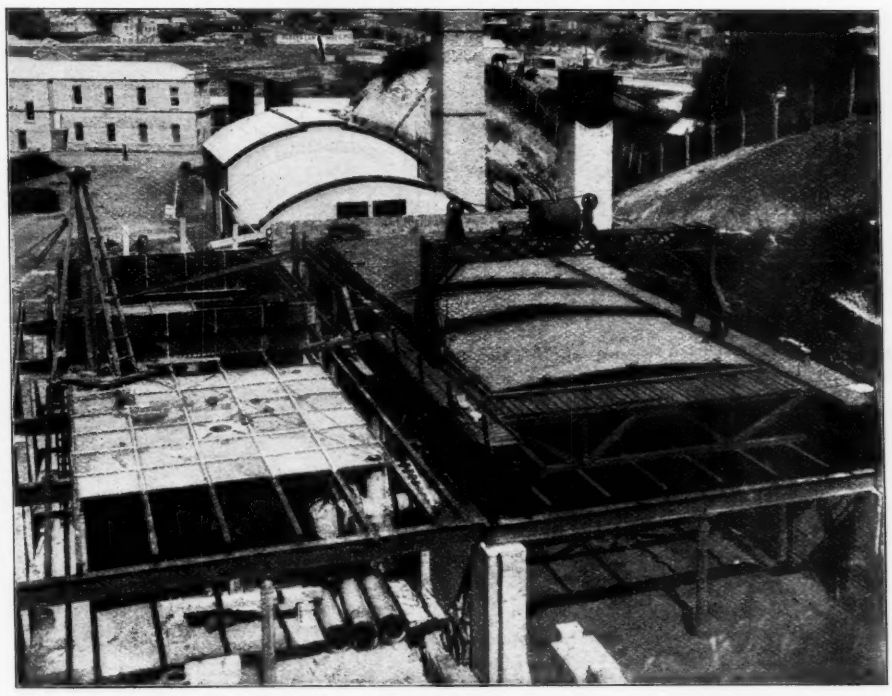


Fig. 6.—A General View of the Purifiers and Yard

matic circuit-breaker, and then to a "negative" distributing board. Thence they are led to the motors of the projector and the reversing controller of the propeller motor.

There are five speeds of propelling or hoisting—all attained by means of "tramway" metallic resistance boxes. To prevent over-winding of the projector or hanging frame, an automatic stopping gear is attached to the machine, by which the controller would be returned to the "off" position as soon as either of them reached its maximun height.

Two bare copper conductors are stretched along the whole length of the retort-house, formed of hard-drawn copper wire ¼ inch diameter, resting at intervals on insulated hanging "standards" of the tramway type, suspended in cast-iron brackets. These leads connect with the dynamos by an insulated cable across the yard. The electric generating plant, erected in the exhauster room, is looked after by the exhauster attendant.

The dynamos are in duplicate, capable of developing 20 kilowatts at 220 volts, and are of the continuous current compound-wound type, with ventilated multipolar slotted cylinder drum armatures. The framework, of annealed cast steel, is built in two halves. The bearings have phosphor-bronze bushes and self-lubricators, and are fitted with drawn cocks and sight-feed gauges. The dynamos are driven by a steam-engine manufactured by the Bryan Donkin Company, having a 14-inch diameter cylinder and 14-inch stroke, with two fly-wheels and running at 130 revolutions per minute. The engine is fitted with a Pickering governor and throttle-valves, and the necessary sight-feed and other lubricators.

The switchboard is of the split type, consisting of two white marble panels fixed to a steel frame, secured to the exhauster room floor. The switchboard contains the following fittings: A volt-meter, an ampere-meter, a cut-out switch for the volt-meter, one double-pole quick-break switch "Peels," four single-pole fuses for ditto, two dynamo field rheostats, one single-pole automatic maximum cut-out, one ground detector and lamps, and two branch switches for ditto—all fitted in accordance with the Liverpool, London, and Globe Insurance Company's catalogue.

The machinery (the first of its kind erected in Australasia) has been working since November last in a satisfactory manner. In erecting plant so far away from the makers, little hitches, troubles, and delays are expected—especially in an absolutely new kind of machinery as this is. The men are not used to it; and certain men, expecting to be replaced by it, do not look upon its introduction with favour. The makers do not always remember that the only guide to the satisfactory erection and working of such an installation is a complete set of correct detail drawings.

Every part of (say) a crusher should be made extra strong, and all wheels where possible shrouded at least on one side—especially the main driving-wheels, which are subjected to severe and intermittent shocks, not only from lumps of hard coal but from pieces of iron, wood, and other foreign matter sometimes found in the coal. Makers cannot give too much attention to this matter, so that when an obstruction gets into the crusher the machine is "brought up" rather than any teeth broken.

Condensers.—The condensers are of the annular design, having an inner tube 2 ft. 9⅜ in. diameter, and an outside tube 3 ft. 8⅞ in.

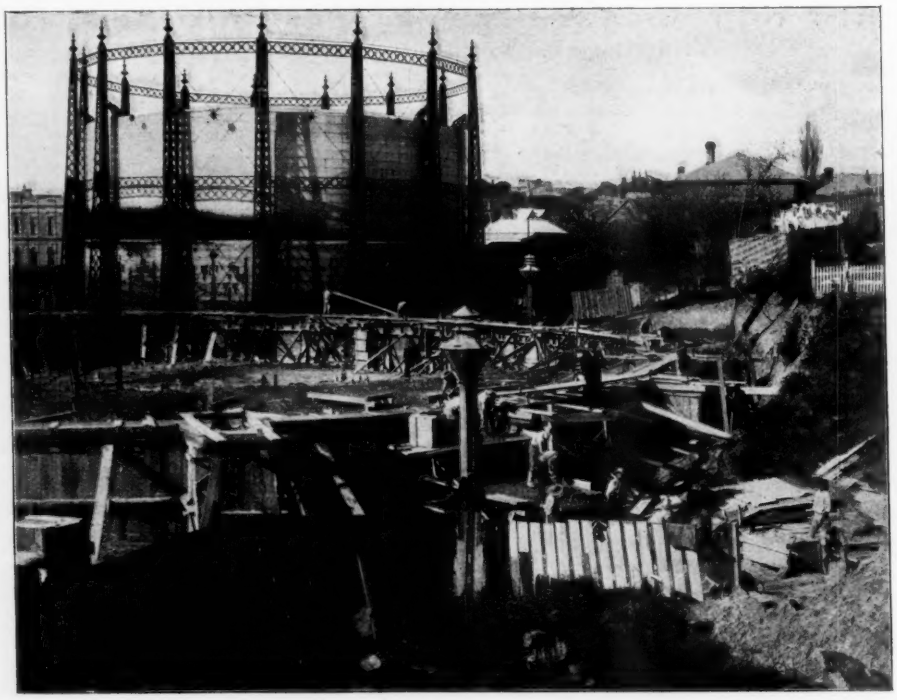


Fig. 7.—The Gasholder Tank under Construction.

diameter, leaving a space of $5\frac{3}{4}$ inches between. The travel of the gas ascending the first column passes to the second through a connecting pipe, and downwards into the bottom of the third column, and so on. The outside row is of slightly different design, having been taken from the old works. These condensers are so arranged that the gas can pass through any one set, or seriatim through all at will. Each column is supplied with an automatic tar-overflow leading to the tar-storage tank.

Exhausters.—At the present time the exhauster-house is constructed of corrugated iron, with a dome-shaped roof, well ventilated. All the principals were manufactured upon the works. Before long, I hope to replace this iron structure with a brick building, giving scope for a more architectural and pleasing design, and more creditable to the high-class machinery it contains. The floor of the building is several feet above the yard level, allowing easy access to all the mains underneath. From the condensers, the gas is drawn by two Donkin exhausters, so arranged that they can be duplicated in minimum time and cost; the steam-engines being large enough for two exhausters and the brick foundations being all ready for the duplicate plant. The engine is controlled by a hydraulic regulator and equilibrium steam throttle-valve. This room, as previously stated, contains the electric generating plant; here is also placed the "gauge" battery and compensator.

Livesey Washers.—There are two Livesey washers, one to pass 2 million cubic feet per day and the other $1\frac{1}{2}$ millions.

Scrubber.—This is one of Messrs. Holmes and Co's. patent scrubbers, to pass $1\frac{1}{2}$ million cubic feet per day, with arrangements for erecting another alongside it.

Purifiers.—At the present time, the purifiers consist of four 25 feet by 30 feet by 5 feet boxes; the first two being manufactured by the Whessoe Foundry Company, the second two by Messrs. Newton, Chambers, and Co., and four purifiers from the old works, 25 feet square. The purifiers are raised 13 ft. 8 in. above the yard; and are supported on longitudinal joists, resting on cast-iron columns and the outside brick building. In the centre of the bottom of each purifier is placed a heavy swing door, 2 feet diameter—the opening being continued up to the top of the oxide, in circular castings, with the necessary ribs and lugs for supporting the bearer bars. When emptying the box, as the oxide is dug

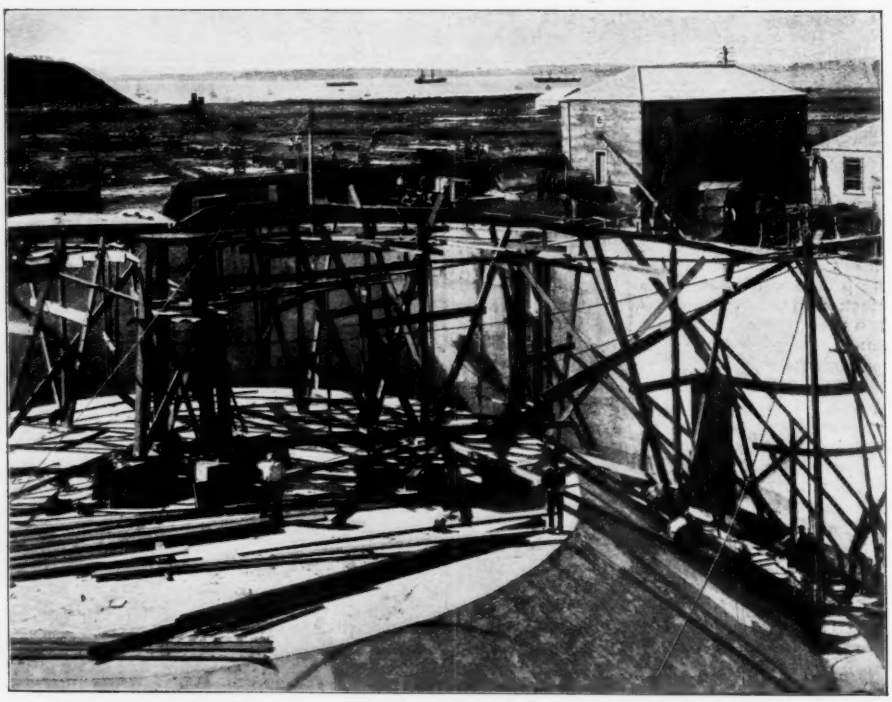


Fig. 8.—The Tank in a More Advanced State—Showing the Gasholder Crown Support.

out, different sections of the pipe are removed, and the oxide shot to the revivifying floor below. After being spread and revivified, the oxide is raised to the necessary height, and transferred to the purifiers. The purifiers have water lutes, 8 in. by 2 ft. 6 in. deep. The covers are raised by means of a traveller, worked by the water pressure of the town—about 80 lbs. per square inch. The water passing into the hydraulic cylinders drives back the ram having triple gearing, so that the cover is lifted to the necessary height and conveyed on to the next purifier. By a very simple arrangement of two carriages and four lifting-screws, the traveller can be transferred from side to side of the house in a few moments—thus obviating the expense of a second traveller. The girders supporting the purifiers were manufactured at the works and the brick building and purifiers were erected by our own men. A general view of the purifiers and yard is shown in fig. 6.

Station Meters.—There are two station meters, one being manufactured by Messrs. Parkinson and Cowan, of recent date, and the second one having been removed from the old works, with the usual inlet and outlet and bye-pass connections.

Tar and Liquor Tank.—This tank is 60 ft. long by 30 ft. wide by 20 ft. 3 in. deep, to the springing of the roof. It is constructed in brickwork. The top of the tank is 4 feet below the surface of the ground, thus giving ample room for the mains of the washers and scrubbers. At the north end of the tar-tank is placed the tar and liquor pump-house with tar-tanks on top, into which the tar is pumped and allowed to settle prior to being drawn off by gravity into the casks as required. The pumps were manufactured by Messrs. George Waller and Co., and are driven by a steam-engine brought from the old works. In the winter time there is very little demand for tar, while in the summer we readily sell all we make. The pathways in all the suburbs are annually tarred. Several experiments have been made in tarring roads; and I hope by this means a greater demand for tar may be created.

Boilers.—The boilers are in duplicate, each 160 H.P., made by Messrs. Babcock and Wilcox. In consequence of being able to pack these boilers in a small space, they are especially suitable for the Colonies, where the freight by sea of a Lancashire boiler of equal horse power would be a very expensive matter. The boilers are supplied with forced draught.

Concentrate.—There being very little demand in the Colonies for sulphate of ammonia, all our ammoniacal liquor is concentrated up to about 90° to 100° strength, and shipped to Sydney in very strong wrought-iron drums for further purification—to be afterwards used by the different freezing companies. By this means, we readily dispose of all our liquor—giving us a good return for the outlay. The plant is an inexpensive one, and is attended to by the boiler attendant.

Gasholders.—The gasholders are erected on a site some little distance away from the main works. The small one, a telescopic holder, 105 feet diameter and 30 feet deep each lift, was erected some years before I came to the Colonies. The second holder is also a telescopic one, being 150 feet diameter by 33 feet deep each lift, and was erected in 1901, on the site of a small holder, which latter, being of very light design, was not heavy enough to be of much service for the town supply. The gasholder tank was constructed as shown in figs. 7 and 8. The holders are shown in fig. 9. The new one is so arranged that a third lift can be erected at a minimum cost; space being left between the present outer

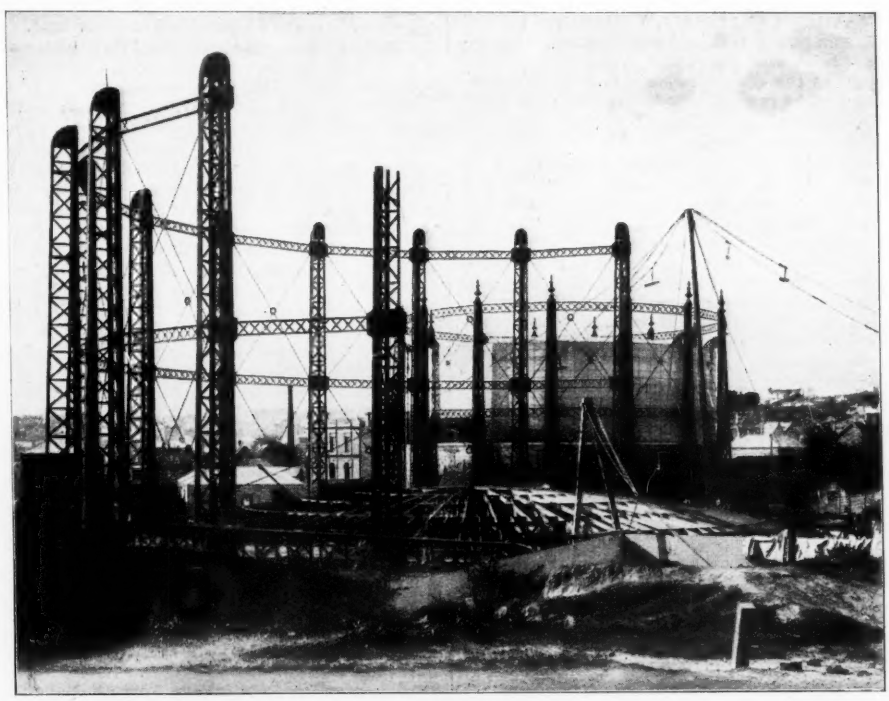


Fig. 9.—The Gasholder Framing being Erected.

lift of the tank, and the standards being finished with a cap which on its removal leaves the top of the standard with all the holes ready for attaching another lift. When capped, this gasholder gives a pressure of 6½ inches. Its total storage is 1⅛ million cubic feet; and as at the present time our consumption on some days exceeds 1½ millions, the erection of the third lift will have to be completed before long. Out of the holder taken down, we manufactured a small holder recently erected at Devonport, as will be described hereafter.

Governors.—The governors are placed on the same site as the gasholders. I arranged the mains some years ago; erecting two small receivers, one for the inlet of the gasholders, the other for the outlets, upon which are connected five governors. Some were made by Messrs. J. & J. Braddock, and the later ones by Messrs. W. & B. Cowan. A Cowan safety governor connects the two receivers, so that should the attendant inadvertently shut off one governor before opening the valve of another, gas is returned from the inlet receiver to the outlet in sufficient quantity to keep the town mains quite full of gas, and thus prevent any serious deficiency.

Offices and Workshops.—The works office is a very commodious building, having in the basement a room 53 ft. by 18 ft. 6 in., sufficiently large for nine clerks and two foremen of different departments. On the first floor is the drawing office and engineer's office, having a wide and expansive view over the whole yard.

Some few years since, in consequence of the faulty work done in fitting up many of our private residences and warehouses, we decided to take over the whole of the work of fitting up buildings with gas (up to the burner) when requested to do so. The appreciation of this step is shown by the fact that we now have twenty gas-fitters and two inspectors constantly employed on the work of the town. This entails a large amount of imported gas-fittings and necessitates a large stock of fittings, all of which are imported from England. We have also eleven men attending to general complaints, stoves, meters, &c., and eleven meter-waterers. The work of the stores—debiting the different contracts with the material used and crediting them with the material returned—is in charge of a chief storeman and two assistants. On the ground floor are all the fittings daily required, and the heavier goods—such as pig iron, steel, oil, &c.; while on the floor above are stored the lighter articles—such as meter drums, stove pipes, &c. The building is of brick, with pilasters; the windows and doorways being in relief in bricks of a darker colour.

The repair of meters constitutes another important branch of our business. Being so far away from the meter makers, we have to keep qualified men to repair any damaged meters, as well as to test them prior to being sent out to our customers. Above the meter-repairing shop is a meter-store; and fairly large stocks of meters have to be kept. Next the meter store on the same floor is the mechanics' shop, containing two lathes and the necessary benches for four fitters. In the town are erected some gas-engines; and in this shop we do the necessary work of repairs and erection, keeping three fitters on this particular work.

Further on is the engineers' and smiths' shop, containing three smiths' fires, a gas-hammer, two punching and shearing machines, one radial drilling machine, and one smaller drilling machine, a

pipe and bar-iron cutter, a power machine for screwing pipes, and the necessary benches, &c., required for such a shop. In this shop I have constructed all the plate girders, iron roofs, and other work required throughout the gas-works at much less cost than they could have been secured outside.

Water Storage.—At the bottom of one of the gullies in the paddocks (as previously mentioned) a large storage tank was constructed to collect the water from the paddock. This is used for quenching coke and for other purposes. As soon as the present excavations are completed, the water now coming down the second gully and that accumulating on the roofs of the different buildings will be collected in another tank and used for general purposes. This will make a big reduction in our water account.

Distribution.—Auckland is one of the most difficult towns to adequately supply with gas in the ordinary way—due to its inequality of surface. The town is constructed on a succession of hills and gullies; there being no means of supplying gas but by following the delineation of the ground. We have about 200 miles of mains of different sizes, extending out to districts 7 and 8 miles distant from the works. One main supplies gas to Onehunga on the west coast of the island, some 8 miles away. Onehunga is only a few feet above the level of the sea; and to keep up a sufficient supply of gas to the town (of between 3000 and 4000 inhabitants) a gasholder, 60 feet diameter by 18 feet deep, is placed on the highest point, about mid-way between the works and Onehunga. By this means, an extra supply of gas is drawn from the holder and pumped down to a second holder in the low-lying town, requiring a pressure of about 9 inches, and distributed from the second holder in the usual way.

I intend at some future date to encircle the town with a high-pressure main. On the south-west side of the town, a main has been extended out a distance of 3¾ miles, which at the present time is a low-pressure main, but will be turned into a high-pressure one next summer time, with underground governors on the main branches leading to the different districts. On the south-east side of the town, I laid a main in 1903 for a distance of about 6¾ miles, taking off gas where required by means of underground governors—the gas in the main being at gasholder pressure. By this means, I have been able to give a sufficient supply of gas to some of the low-lying districts in Parnell and Remuera, and supply the whole borough of Ellerslie. Had mains of sufficient size been laid to carry the gas at ordinary pressure, the cost would, of course, have been much greater.

High-Pressure Distribution.—Two outside districts, Otahuhu (a distance of 4¾ miles from our nearest main) and Lake Takapuna (3¾ miles distant), though both independent flourishing boroughs, have intervening districts in which there would be little consumption, especially the former case, where a long distance of solid rock has to be traversed. It was, therefore, decided to supply both the districts with gas through a small wrought-iron main, and pump the gas at the necessary pressure into a holder erected in each of the above districts, from which the gas will be distributed in the usual way. Lake Takapuna is in direct communication with one of the Company's branch works, and so the holder can be filled at any time of the day; but in the case of Otahuhu, which will be supplied from the end of the high-pressure main on the south-east side of the town, pumping will have to be done in the early morning. The holder in the Lake district is amply large enough to supply the town during twenty-four hours for some years to come. The gas will be compressed by means of a Rand compressor made by the Ingersoll Company, of New York. The high-pressure main and the cast-iron mains have been laid to the Lake district. The holder is erected, and everything is ready for the compressor, which is expected here shortly.

Prior to laying the wrought-iron pipes, they are dipped in a solution of half bitumen and boiled tar; the mixture being brought to boiling point and the pipes heated and dropped into the solution—the ends being stopped by plugs of special shape. This solution makes a splendid preservative; and if applied after the pipe has been heated, or properly dried, it will adhere so tenaciously that very little is scraped off by the tongs when screwing them together. Did this occur before filling in the trench, the bare place was brushed over with a little fresh solution.

Devonport Gas-Works.—At Devonport, we have a small complete works manufacturing at the present time 95,000 cubic feet of gas per day. This I have recently re-modelled—practically rebuilt it, having increased the size of the retort-house and coal-store and doubled the number of retorts. We are now erecting new condensers, washer, meter, purifiers, gasholder, governor, and laying new mains. At these works there are two holders—a single-lift one of 29,000 cubic feet capacity, and a new one just erected of 73,000 feet capacity, with cup and single lift prepared for telescoping. It is at these works that the gas will be compressed and sent to the gasholder at Lake Takapuna. This will make the fifth gasholder I have designed and erected for the Company—one in Auckland, one in Devonport, one in each of the two townships to be supplied with compressed gas. The other two were for increasing the existing storage made necessary by the geographical position of the various districts supplied.

Fire-Brick Works.—At the fire-brick works, I make nearly all the fire-brick goods required for ourselves, as well as for many of the gas companies in New Zealand. Fire-clay of a very high quality is found in New Zealand—better than the majority of English fire-clays—from which we make fire-goods of the very best quality. Our own requirements being so extensive, I have been of recent years often forced to refuse many outside orders. Shortly, I hope to be able to put up a more modern and up-to-date plant, which will enable me to make fire-goods at a cheaper rate, and materially increase the output of the works.

Laboratory.—We have at Auckland a laboratory fitted up with most of the modern appliances for testing gas.

General.—As previously stated, the new Auckland Gas-Works will manufacture 2 million cubic feet of gas per day. When designing and constructing works of this magnitude so far away from the source of production, it entails an amount of attention and consideration of details hardly realized by those who have not had such experience. A few omissions on the part of the contractor might mean considerable inconvenience, as a "telephone call" or a "wire" will not bring the missing article along the next day. One has therefore to rely, in such cases, on his own resources.

THE POWER OF SCIENTIFIC REFLECTION IN GAS-FIRES.

From a gas-fire the aim of inventors is to secure the greatest amount of radiant heat for the lowest possible consumption of gas. The further the one quantity recedes from the other, the greater the advance, and the greater the success of the gas-fire maker. The gas-fire maker has not sufficiently appreciated until now the aid that reflection—scientifically applied and not haphazard—will afford him in his strivings after full efficiency. To Messrs. Wilsons and Mathiesons must be accorded the credit for having made a real advance in the application of reflection, united with another aid to the effective utilization of heat. The arrangement by which they have accomplished this has been patented.

The way that fires are commonly constructed conduces to a certain amount of the heat generated being carried sharply away under the fender and on to the chimney; and it has occurred to some active brain connected with the above-named firm that if this heat can be saved and transmitted into the room, the effective heat from a given consumption of gas will be the higher. A practical way of achieving this seemed to be to have a movable projecting fender set in front and close to the fire. But before the proper fender was realized, there was much experimenting. It was found that a flat-topped fender, no matter whether surfaced with glazed tiles or polished metal, did not give the result that it was felt should be obtained. Makers had tried the same thing before, but had not found sufficient benefit from it to make any special claim in regard to it, other than the convenience of having a stand on which to keep a tea-pot or other utensil hot. But Messrs. Wilsons and Mathiesons felt there was a way with benefit in it by which an intensified efficiency could be realized; and eventually continued experiment disclosed an angle for the top of this adjunctive fender, combined with a polished corrugated copper surface, which fully achieves what was sought. It is a simple addition to a fire; but it is very effective.

The proof of the pudding is in the eating. By thermopile and galvanometer, we witnessed, at the London show-rooms, the registration of quite 30 per cent. additional heat projected obliquely from the fire into the air of the room; while on the removal of the reflector, with the thermopile in the same position, the galvanometer needle returned to the position that it occupied before the application of the inclined surfaced fender. Bringing the face, as being the most sensitive exposed part of the body into the line of the reflected heat, and then removing the fender, the difference was surprisingly great. Let it not be misunderstood that there is any claim of the heat developed by the fire being any greater; but the claim is that the developed heat is made more valuable by this addition to the fire of a fender with the polished copper surface at a prescribed angle. The inclined reflector, too, increases the cheerful appearance of the fire; and, by comparison, the fire with which the demonstration was made looked quite dull when the reflector was removed. There is another point about the fender. Its depth from front to back has something to do with its efficient action. This fender is 6 inches deep; narrower ones are not nearly so effective.

A further feature is that the under part of the fender is formed with curved division plates extending from top to bottom. The object of these is to form channels through which flows cold, pure air from the lower part of the room; and the curvature of the division-plates causes the air in its travel to impinge on them and become heated. The burners are thus provided with a primary supply of heated air; and the surplus not required for the purpose passes up the back of the stove, and from the top is emitted into the room. A smoke test is the proof that the passage of the air is as stated.

The firm are pleased with this addition to the commendable features of their fires. It is certainly a marked advance in the efficiency of the latter; and so, there is confidence in saying, it will be conceded by those who give it trial.

High-Pressure Gas for Lighting and Heating.—A lecture on this subject will be delivered before the Birmingham and District Master Gas-Fitters' Association on the 25th inst., at the Acorn Hotel, Temple Street, Birmingham, by Mr. A. W. Onslow, the Gas Engineer at the Woolwich Arsenal.

MUTUAL COMPENSATION SCHEMES.

In the course of a notice in the "Journal" for the 17th ult. of the rules of the South Metropolitan and South Suburban Gas Companies' Accident Funds, which had been revised in order to make them comply with the new Compensation Act, reference was made to the particulars which appear in the Annual Report of the Chief Registrar of Friendly Societies with regard to mutual schemes entered into between employers and employed for "contracting out" of the Act. There is before us now the report for the year ending Dec. 31, 1906, of the Chief Registrar (Mr. J. D. Stuart Sim); and, in accordance with custom, it contains details of the mutual compensation schemes which were in operation at June 30 of that year.

The passing of the new Workmen's Compensation Act last year has, the report points out, altered to a considerable extent the provisions enabling employers and workmen to "contract out." The scales of compensation in a scheme are to be "not less favourable to the workmen and their dependants than the corresponding scales" contained in the Act; if the workmen contribute, the scheme must confer benefits at least equivalent to those contributions in addition to the benefits to which the workmen would have been entitled under the Act; and a majority of the workmen (to be ascertained by ballot) must be in favour of the scheme. These requirements, Mr. Sim remarks, appear somewhat drastic; but the Registrar is not deprived of the discretion given him by the Act of 1897 in comparing the benefits under a scheme with those under the Act. The scales need not be absolutely identical. He has still the right "to consider the scales as a whole; and one scale could be certified as not less favourable than another scale, though in an individual case the compensation might be less under the former than under the latter." Further, the Registrar will still have discretion to certify schemes which, in cases of temporary or permanent disablement and death, offer benefits which are, as regards each of the three classes above mentioned, of an equivalent value to those prescribed under the Act; but there is no requirement that the benefits under the scheme should be identical with those under the Act. The Registrar will also be able to take into consideration any extra benefits conferred under a scheme and not mentioned in the Act—such as pensions, free medical attendance, &c. As regards the scale of compensation, the principal alteration, of course, is that in case of incapacity the payment dates from the time of the accident—unless the incapacity lasts for less than two weeks, when no compensation is payable for the first week—instead of from a fortnight after it. The Chief Registrar is empowered to make regulations; and taking advantage of this provision, a regulation has been drawn up to meet the case of schemes that might be usefully amended in some small particular after having been certified. All schemes certified under the old Act, must be re-certified before Dec. 31 next.

There were two new schemes certified under the Act of 1897 in the year to which the present report refers; but as neither of them was in connection with a gas undertaking, the South Metropolitan and South Suburban Gas Companies still remain the sole two representatives of the industry among the considerable number of schemes of which particulars are furnished by Mr. Sim. However, a few facts regarding the agreements in general may be noted. Particulars are given as to 51 schemes in the present report; the returns relating to one other having been received too late for inclusion. In the aggregate they had been adopted by 102,551 workmen who had contributed during the year to June 30, 1906 (to which date the returns are made up), £36,286; while the amount given by the employers was £52,374. The payments on death were £15,346; and those during incapacity were £54,855, of which £18,500 was for the first two weeks for all cases, £30,107 after the first two weeks, and £6248 in lump-sum payments. In other benefits, there was an outlay of £12,334. The funds reached the large total of £187,970. The number of deaths was 133; and of cases of incapacity, 17,243. The average contribution of each workman came to about 7s. per annum. The Great Eastern is the one railway represented; and here there were 23 deaths, and 3055 cases of incapacity. The average contribution of each workman appears to have been 1d. per week, which realized £6090; the Company gave £10,552. Eighteen schemes in connection with factories of various kinds in England and Wales have been adopted by 19,616 workmen, out of a total of 20,943; and they contributed £2925 during the year (or about 3s. each), the employers' share amounting to £5948. This shows that, in the past, where such schemes have been adopted at all, it has been with almost the unanimous approval of the employees. In three schemes all the contributions were paid by the employers. The payments made on death (three cases) were £1089; during incapacity (1335 cases), £3954; and for other benefits, £1857. The funds at the end of the year amounted to £10,326. In connection with mines, 27 schemes had been adopted by 50,269 workmen, who contributed £26,570 (or an average of a little over 10s. 6d. each), while the employers gave £34,036. The total payments for death (104 cases) were £10,531; for incapacity (12,225 cases), £37,489; and for other benefits, £9490. The funds at the end of the year amounted to £116,647. In addition to these, there was one scheme in connection with a quarry; and two were in operation in Scotland.

In 27 cases a comparison has been furnished between the amount actually paid during incapacity and the maximum that would have been payable under the Act; and the result is that a difference is found to exist amounting to nearly 57 per cent. in favour of the schemes. In the aggregate, particulars were returned of 17,232 completed cases of incapacity; and in nearly 50 per cent. of the total number, the duration of incapacity was two weeks and under—the cost being £7162, or an average of 16s. 9d. for each case. In 1·34 per cent. of the cases, the incapacity exceeded 26 weeks; the average duration being 55½ weeks, and the cost to the funds £31 10s. 6d. for each case, or 11s. 4d. per week of incapacity. From the 27 returns above referred to, giving information as to the estimated maximum amount that would have been payable under the Act, it appears that the workmen would have been entitled to receive £6126, whereas the amount actually paid to them under the respective schemes was £10,055. Payments of gross sums amounting to £6248 were also made during the year in connection with cases of incapacity.

With reference to the schemes of the two Gas Companies, the report shows that, in the case of the South Metropolitan Company, the whole of the 6361 men employed "contracted out" of the Act; their contributions for the year to June 30, 1906, amounting to £558, and those of the Company to £1193. The payments on death and to dependants came to £581, although there was actually in the twelve months included in the return only one death. There were 200 cases of incapacity, in connection with which £746 was paid. In other benefits £18 went, making a total expenditure of £1345. The funds at the end of the year amounted to £670. In the case of the South Suburban Company, also, the whole of the 676 men employed joined the mutual compensation scheme; and they contributed £59, and the employers £132, while other receipts figure at £9. Nothing was paid on account of death; but £139 was distributed on 44 cases of incapacity, and £14 on other benefits. This made a total outlay of £153; and the funds remaining at the end of the year amounted to £312. It is estimated that the maximum amount payable under the Act for incapacity would have been £71, as against the £139 actually distributed under the scheme.

The report contains a table compiled for the purpose of arriving at the estimated cost of giving compensation after one week of incapacity from injury, as compared with two weeks. The information is, of course, based on the certified mutual schemes, two-thirds of which provide for payment from the date of injury. The total payments for the first two weeks of incapacity during the years 1904 and 1905 amounted to £35,187; and of this it appears that the first week of incapacity cost the schemes £19,608—leaving £15,579 as the cost of the second week.

COAL AND COKE STATISTICS FOR 1906.

Highest Recorded Output of Coal.

With regard to the Government Blue-Books published this year there is one fact, at any rate, which stands out prominently—and it is that by some means or other the publication has been so expedited as to result in their issue, as a rule, some weeks earlier than was the case with the corresponding ones last year. This remark applies to Part III. of the Home Office Report on Mines and Quarries, which furnishes information regarding the minerals raised during 1906, and their value, as well as the amount and value of the exports and imports.

Following in the footsteps of the records of recent years, the total output of coal during 1906 made another record. The amount was 251,067,628 tons, as compared with 236,128,936 tons in 1905, or an increase of 14,938,692 tons; while the value was £91,529,266, or £9,490,713 more than for the preceding twelve months. This additional sum was accounted for not only by the extra quantity raised, but by a rise in the average price from 6s. 11·38d. to 7s. 3·49d. per ton at the pit. The recent progress in the output will be seen when it is mentioned that in 1901 the figure was 219,046,945 tons; in 1902, 227,095,042 tons; in 1903, 230,334,469 tons; in 1904, 232,428,272 tons; in 1905, 236,128,936 tons; and in 1906, 251,067,628 tons. The value per ton at the mines over the past four years has been: In 1903, 7s. 7·93d.; in 1904, 7s. 2·58d.; in 1905, 6s. 11·38d.; in 1906, 7s. 3·49d. While therefore the average value of the coal at the pit was higher last year than in the two years immediately preceding, it was still a good deal below that of 1903.

Turning to the report to see where the enormous increase in the output last year of 14,938,692 tons came from, it is seen that England has to be credited with by far the greater portion of the gain—namely, 10,013,038 tons—though Wales (with an addition of 2,769,255 tons), Scotland (with an increase of 2,153,072 tons), and Ireland (with 3327 tons more) are not proportionately so far behind as the figures would seem to indicate. The total output in England was 174,993,130 tons, in Wales 37,988,467 tons, in Scotland 37,992,369 tons, and in Ireland 93,662 tons. As usual, the term "coal" as used in these statistics includes anthracite, the total output of which in 1906 was 3,377,523 tons, having a value of £1,522,437. This item also shows an increase on the preceding year, when the output was 3,112,054 tons; the value being £1,340,931. Having seen how the output of the different countries compares, let us look at the average prices per ton at the pit's mouth in the different fields. These were as follows: Scotch

coalfields, 6s. 5·5d.; Northern, 6s. 10·7d.; Yorkshire, &c., 6s. 7·4d.; Lancashire and Cheshire, 7s. 6·34d.; Midland, 6s. 8·23d.; small detached coalfields, 7s. 11·65d.; North Wales, 7s. 4·92d.; South Wales, 9s. 3·89d.; and Irish, 8s. 10·75d. The average price for England was 7s. per ton, for Wales 9s. 5d., and for Scotland 6s. 5d.; while, as already remarked, over the whole of the fields it was 7s. 3·49d. per ton. The average price in the London market was 15s. 9d. per ton in 1906, as compared with 15s. 6d. in 1905, 15s. in 1904, 15s. 10d. in 1903, 18s. 1d. in 1902, 19s. 5d. in 1901, and 22s. 9d. in 1900.

The quantity of coal exported (exclusive of coke and patent fuel, and of coal shipped for use by steamers engaged in foreign trade) was 55,599,771 tons, which was an increase of more than 8 million tons on the exports of 1905, which amounted to 47,476,707 tons. In 1904 the figure was 46,255,547 tons; and in 1903, 44,950,057 tons. The declared value of last year's exports was £30,069,307; and of those of the preceding year, £24,859,129. In addition to this, there was in 1906 the equivalent of 1,358,706 tons of coal exported in the form of 815,224 tons of coke, and of 1,239,488 tons in the shape of 1,377,209 tons of patent fuel. If to this be added the 18,590,213 tons of coal shipped for the use of steamers engaged in the foreign trade, we arrive at a total quantity of coal shipped of 76,788,178 tons. The declared value of the exports of coke was £593,785, and of patent fuel £841,199. Turning to the countries to which coal was exported, it may be remarked that in 1905 Germany took 7,626,377 tons, France 6,731,655 tons, and Italy 6,412,686 tons. In that year these three countries were our largest customers; and the same statement applies to last year's trading. The relative positions held by the three countries are, however, different; for Germany instead of being first is relegated to the third place—France having taken the lead in consequence of an increase in the amount of coal she received from us of very nearly 3 million tons. The exact figures for 1906 were: France, 9,444,528 tons; Italy, 7,810,024 tons; and Germany, 7,629,653 tons. The report contains one table which is always of small dimensions, and does not on the present occasion differ to any extent from its predecessors. It is "Quantity and Value of Coal, Culm, and Cinders imported into the United Kingdom." The total quantity for 1906 was no more than 48,943 tons, having a declared value of £47,100; the corresponding figures for 1905 having been 48,501 tons and £42,582. Of this insignificant total, 48,318 tons came from the Netherlands, leaving only about 600 tons from all other sources. Australia figures for only 3 tons; while the United States is not even mentioned. Having satisfied the drain on our resources represented by the shipping of 76,788,178 tons of coal in all forms, there remained of the total output of 251,067,628 tons 174,279,450 tons of coal for home consumption for all purposes; and reckoning the population of the United Kingdom at 43,659,121, this represented a quantity of 3·992 tons per head, which, it may be pointed out, is a larger amount than in any year since 1900, when the figure was 4·075 tons per head of the population.

The particulars with reference to the manufacture of coke and briquettes, which were (in accordance with a suggestion of the Royal Commission on Coal Supplies) given for the first time in last year's report, are continued in the one now under notice. On the present occasion, returns of production of coke were furnished by 234 colliery owners, 1485 gas companies, and 23 other owners of coke ovens. There are no compulsory powers of obtaining the information, so that the returns are not necessarily complete; but it is believed that the figures contained in the tables in the report may be taken as approximately correct. Returns as to the manufacture of briquettes were obtained from all firms known to be engaged in the industry. In England, 30,946,695 tons of coal were used in the production of 17,040,682 tons of coke, of a value of £11,079,328. For Wales, the figures were 1,596,838 tons of coal, in making 959,321 tons of coke, of a value of £691,544. For Scotland, 2,508,484 tons of coal, in making 1,173,345 tons of coke, of a value of £670,032. For Ireland, 330,796 tons of coal, in making 118,122 tons of coke, of a value of £102,922. For the Isle of Man, 19,864 tons of coal, in making 5056 tons of coke, of a value of £5290. The total quantity of coal used in the United Kingdom was 35,402,677 tons, in making 19,296,526 tons of coke, of a value of £12,549,116, as against the previous year's 33,452,943 tons, in making 18,037,985 tons of coke, of a value of £10,625,799. There were in use in 1906 a total of 29,728 coke ovens, compared with 31,060 in the preceding year. The falling off was practically wholly in connection with the beehive ovens, the number of which was reduced from 25,514 to 23,454. The remainder were made up as follows: Simon-Carvés, 808; Semet-Solvay, 670; Coppée, 2308; Bauer, 52; Koppers, 108; Otto-Hilgenstock, 768; Simplex, 78; and other kinds, 1482. According to the returns received from 257 works where coking plant is in use, at 51 of these bye-products were recovered in 1906. With regard to briquettes, in the whole of the United Kingdom 1,399,542 tons of coal were used in their manufacture; the value of the product being £899,046.

Glancing at particulars given in the report regarding other materials than coal, it may be remarked that both the output and value of the bog ore raised in Ireland was greater last year than in any twelve months since 1897; the figures being: 1906, 5425 tons of a value of £1356; 1905, 3205 tons, value £801; and 1897, 7124 tons, value £1781. No natural gas was obtained last year; but 10 tons of petroleum were secured in Dumbartonshire, the value of which is placed at £15, as compared with 46 tons, of a value of £69, in 1905. The imports of petroleum into the United Kingdom in 1906 showed a slight falling off as compared with the preceding year though the value was greater; the figures being 299,220,607 gallons (value £5,845,059), against 300,110,335 gallons (value £5,423,124). The sources of this huge supply were: Russia, 40,598,357 gallons in 1906, and 68,493,036 gallons in 1905. The United States, 211,750,612 gallons in 1906, and 206,718,108 gallons in 1905. Other countries, 46,871,638 gallons in 1906, and 24,899,191 gallons in 1905. The further deficiency from Russia (the imports from this country in 1904 were no less than 129,599,066 gallons) was, it will be seen, more than made up by the additional quantities received from the United States and other countries. The value of last year's imports was: From Russia, £715,567; from the United States, £4,177,680; and from other countries, £951,812.

CALCIUM CYANAMIDE AS A FERTILIZER.

As most people are aware, calcium cyanamide is the systematic, chemical name given to a substance made by electricians by heating calcium carbide in a furnace in a current of nitrogen. From many experiments carried out on a small scale, it has been found to possess a certain amount of manurial value; and the manufacturers, therefore, propose offering it for sale as a fertilizer if they find they can produce it at a price enabling them to compete with sulphate of ammonia and nitrate of soda. Calcium cyanamide is scarcely on the market yet; but it has been produced in small quantities for two or three years, and has been submitted to various well-known agricultural chemists on the Continent and even in this country. Some experiments appear to have been conducted on a reasonably large scale; but most have been simply pot trials, and therefore the results obtained do not necessarily indicate the true value of the proposed new fertilizer in the hands of a farmer. Nevertheless, it may be well to study the conclusions arrived at by the different investigators who have made these earlier experiments; and therefore the following account of an article which appeared recently in "Die Landwirthschaftlichen Versuchs-Stationen" [Reports from German Agricultural Laboratories] may prove of interest.

The experiments summarized in the article were carried out in different places by Dr. P. Wagner and Herren B. Dorsch, S. Mals, and M. Popp, and were instituted in order to compare the practical efficiency of other nitrogenous fertilizers with calcium cyanamide. The results show that ammonium sulphate and ammonium nitrate exhibit comparatively little difference in the effects they produce. Ammonium carbonate is of equal value with ammonium sulphate and ammonium nitrate in a loamy soil. In a sandy soil, however, the carbonate is only useful when applied in quantity not exceeding 0·75 gramme of nitrogen per pot—larger doses being prejudicial. An amount of calcium nitrate equal to two standard doses—*i.e.*, 1·50 grammes, may be applied to a loamy soil, and an amount equal to three doses (2·25 grammes) may be applied to a sandy soil with beneficial results. Larger quantities, however, are harmful—especially in loam. The high proportion of lime in calcium nitrate, and the still higher proportion contained in the basic salt, are detrimental. A single application of calcium cyanamide in quantity equal to 0·75 gramme of nitrogen per vessel is beneficial; but the results are not quite so good as those produced by an equivalent dose of the other nitrogenous fertilizers. More copious applications of calcium cyanamide than that mentioned are harmful. If the beneficial effect produced by ammonium nitrate or ammonium sulphate is termed 100, the effect produced by employing fish guano is, on an average, equal to 78. Fresh vegetable matter is precisely equal to fish guano when used in sandy soil; but in loam it is somewhat less efficacious. In all the experiments, sodium nitrate and ammonium sulphate have given higher yields and a better utilization of the nitrogen than calcium cyanamide.

The general result of all the cultural experiments carried out by the authors named above appears to be that, if the manurial value of nitric nitrogen is called 100, the manurial value of the nitrogen contained in calcium cyanamide is equal to 90. The utility of calcium cyanamide is quickly diminished when it decomposes in the soil in such conditions as to yield dicyandiamide; and the production of the latter body is encouraged by the presence of carbon dioxide, humic acid, warmth, or by a deficiency in the number of micro-organisms in the soil. In order that the calcium cyanamide may give its best results, it must be distributed as uniformly as possible; must be mixed with the earth itself as intimately as possible; and must be applied at least fourteen days before the desired crop is sown. It is also necessary that the soil shall be sufficiently moist; that it shall be a rich loam containing plenty of bacterial life; and that the fertilizer shall not be used later than the middle of February, and in not too large quantities per unit of surface.

Association of Water Engineers.—We learn from the Secretary (Mr. Percy Griffith, M.Inst.C.E., F.G.S.) that arrangements are being made, subject to the consent of the Council of the Geological Society, to hold the annual winter meeting of the Association at the Society's apartments in Burlington House, on Dec. 14. Papers have been promised dealing with "The Water-Works Extensions of Malvern," "The Abstraction of Underground Water from Lands not Specifically Authorized for the Purpose," and "Lessons to be Learnt from the Visit to the Paris Water-Works."

A COMBINED GAS AND ELECTRICITY STATION.

Opening of the Ascot District Gas and Electricity Company's New Works.

INTERNAL combustion engines, and among them gas-engines, have been continually improving, and are now coming to be recognized as the cheapest form of power for the production of electrical energy. So much so is this the case, that the interiors of many electrical power stations, particularly the larger private ones, are quite as much gas as electricity works; and this will in all probability become more and more the case as time goes on. This state of affairs applies not merely, as is often supposed, to small power-houses, but also to the larger ones for the generation of electricity. There are gas-power electricity generating stations at work in this country (where gas has superseded steam) having a capacity as great as 7000 H.P.; while in Germany this power is even more extensively used for the same purpose. It is becoming more and more evident that not only is gas useful on a small scale, but that, under certain circumstances, it will in the future be by far the most economical source of power; and therefore the best interests of the consumer will be served by its adoption, as tending in the direction of cheap supply.

In the early stages of an electricity generating station, the problem is a complex one, particularly in sparsely populated districts, where the proportion of the costs due to irreducible items, such as rates and taxes, wages, &c., is so high. This renders rigid economy a stern necessity in all departments if the undertaking is to pay. One often finds a small district supporting two separate undertakings—one for gas and the other for electricity—each with its own Board of Directors and its own separate managing, engineering, and secretarial staffs, outside men, meter inspectors, &c. These all represent irreducible expenses as long as the concerns are separate; while the position of the companies as purchasers of fuel is also more unfavourable than if they were one concern. It is difficult to see how competition of this kind can possibly be favourable to the consumer, even when the supply companies have cut down their prices to such a figure as to leave them a mere existence instead of a living. These remarks may not be so applicable to large towns, where there is abundance of work to keep the two staffs fully employed in their own grooves; but the more scattered the district the more cogent is the argument, in the consumers' interests, for both undertakings being under one roof.

This was the attitude taken up by the Ascot District Gas Company and their Engineers when applying for parliamentary powers to supply electricity as well as gas at the Board of Trade inquiry. The Company were incorporated in 1882 with a capital of £60,000 and borrowing powers of £15,000; and the area of supply comprised the parishes of Sunninghill, Sunningdale, Easthampstead, Warfield, Binfield, Winkfield, and Waltham St. Lawrence, in Berkshire, and Windlesham, Bagshot, and Bisley, in Surrey. In the year 1905 it became apparent that there was a demand for electricity springing up in parts of the area, particularly in Sunningdale and Sunninghill. After due consideration, the Company decided to endeavour to obtain powers to supply electricity themselves, and to utilize the land adjoining the gas-works as a site for a generating station. They accordingly, in the last session, promoted a Bill in which they sought power to extend their gas limits and to supply electricity throughout the whole of their gas area as proposed to be extended by the Bill, and to raise additional share capital to the extent of £30,000, with the usual borrowing powers. On Dec. 21, 1905, an application was made to the Board of Trade by independent promoters for a Provisional Order to authorize a supply of electricity throughout an area including (*inter alia*) the parishes of Sunningdale and Sunninghill and Windlesham, which were within the Ascot Company's existing limits of gas supply, and the parish of Chobham, which the Company were proposing to include within their limits, and throughout all of which parishes they were seeking power to supply electricity. The promoters of the Provisional Order petitioned against the Company's Bill, and objected to powers for the supply of electricity being conferred in competition with the Order they were promoting. The Company objected to the *locus standi* of the promoters of the Order; but the Court of Referees allowed it. The Select Committee on the Bill were appointed to meet on the 14th of March; but the Company succeeded in getting the consideration of the Bill postponed, to enable the Board of Trade to give their decision on the Order, so that if this was granted the Bill confirming it and the Company's Bill might be considered by the same Committee as competing Bills, and if refused the Company might be saved the expense of a parliamentary contest. They opposed the grant of the Order, and the Board of Trade held an inquiry in order to consider the application.

At this inquiry, though the promoters of the Order were not prepared with any estimates of expenditure or other engineering evidence, the Company were in a position to put forward a complete scheme upon which they had then been advised by Messrs. Handcock and Dykes, the Consulting Engineers. The Board of Trade, however, decided that they could not go into the details of a competing scheme, and the Company were therefore somewhat handicapped in their opposition. The decision of the Board of Trade on the Order had not been given when the Select Committee to consider the Company's Bill was appointed. The advisers of the Company communicated this fact to the Board, and requested them to determine either to grant or to refuse the Order, so that if they granted it the Bill to confirm it and the Company's Bill could still be taken as competing Bills by the same Committee, while if the Order were refused the effect would be to deprive the promoters of the Order of any right to be heard against the Bill of the Company, who would then have an unopposed Bill, as they had succeeded in getting rid of all the other opposition. As a result, the Board of Trade decided not to proceed with the application for the Order; and the promoters immediately withdrew their opposition, and the Bill passed through both Houses of Parliament as an unopposed measure.

The Company are to be congratulated on having been the first gas company to obtain powers for the supply of electricity in the face of a competing application from independent promoters of a Provisional Order. Steps were immediately taken to put their acquired powers into operation, and the Engineers were instructed to prepare the necessary plans and specifications. Tenders were then obtained, and the contracts were finally placed early last May; and current was first turned on to the mains on the 5th inst.—just five months later. The formal opening of the works is taking place to-day, and an account of the proceedings will appear next week. Meanwhile, we give the following particulars in regard to the plant, which have been supplied to us by the Engineers.

DESCRIPTION OF THE PLANT.

The engine-room has been built on the site of the old oxide of iron house, the roof of which was raised some 6 feet to obtain the necessary height for the crane; and the purifier-house has been remodelled, so as to accommodate the accumulators. The buildings have been substantially constructed of red brick with slate roofs—the floor of the engine-room being tiled; and the raised beds of the gas-engines and dynamos are built in brown glazed bricks.

The general plant consists at present of two Hornsby "Stockport" horizontal engines, each capable of working continuously at 90 B.H.P. Each engine is coupled through a flexible coupling to one of Johnson and Phillips's direct-current dynamos, capable of giving normally 460 volts 110 amperes at 210 revolutions per minute. The engines have electric ignition, and are started by means of compressed air provided by a motor-driven air compressor. A petrol starter, with hand pump, is also provided as a stand-by to the compressed air system.

Outside the engine-room there is mounted on iron columns and girders a cast-iron tank, 18 ft. by 12 ft. and 6 ft. deep, which supplies the water for the gas plant and also for the water circulation of the engines. A small centrifugal pump is driven off each engine, to assist the circulation. This tank is supplied from a well in the works by means of a motor-driven pump; and a stand-by supply, to come into action in the event of the well failing, is provided from the Water Company's mains.

Gas is supplied from a Hornsby suction producer, provided with the usual cleaning and scrubbing plant. In addition to the ordinary hand fan for blowing-up the producer, a small electrically-driven blower is provided; the hand blower being merely kept as a stand-by. The fuel used is the coke produced on the works. There is only one producer—a branch from the ordinary gas-main being run, through a meter, into the engine-room, with the necessary gas-bags and fittings, so that either engine can, when desired, be run with lighting gas. The engine-room is spanned by a hand-power overhead traveller, capable of lifting up to 10 tons.

To the left of the main switchboard is a semi-automatic balancer booster, consisting of two balancer motors and two booster dynamos coupled in level. Each booster gives 100 amperes at any voltage from 10 to 90. The shunts of the balancers are cross-connected, and the boosters are reversing, with diverter coils and rheostats, so that they automatically regulate the voltage, and thus reduce very considerably the attendance necessary on the switchboard.

The main switchboard is situated in the wall between the engine and accumulator rooms; a brick chamber being formed behind, giving ample access to the back of the board. The accumulator-regulating switches are mounted in the wall of this chamber, looking into the cell-room, and are actuated by means of spindles and hand-wheels on the main board; thus keeping all the battery connections in the cell-rom. The switchboard consists of the usual dynamo, battery feeder, and middle wire panels; the instruments being of the moving coil type supplied by Messrs. Everett, Edgcumbe, and Co., except the feeder volt-meters, which were made by Messrs. Nalder Bros. and Thompson to the Engineers' designs. In addition to being compound-wound to show the voltage at the ends of the feeders, they have an attachment by means of which an electric bell rings when the voltage rises or falls below a predetermined amount. This plan, which the Engineers have adopted in several of these stations, is exceedingly convenient in the smaller stations, as it obviates, with the assistance of the automatic booster, the necessity of constant attention to the switchboard. The cell-room is very roomy, and contains 240 "Tudor" cells, capable of discharging at 54 amperes for ten hours, with a maximum discharge of 140 amperes for three hours—all the cells being arranged on one tier only.

At present some seven miles of mains have been laid, consisting of three-core paper-insulated, lead-covered cable, by Messrs. Siemens Bros., laid on the solid system in wooden troughing,

All services and straight-through joints are lead wiped joints, and wiped joints are made on to all three-way and four-way disconnecting boxes; the earthing of the lead sheathing being thus continous throughout. Two sizes of distributor cables only are fitted. The meters used are Siemens new pattern ampere-hour meters with cyclometer dials.

The price of current has been fixed for the present at 7d. per unit for lighting and 4d. per unit for power; the voltage of supply being 220 on either side of the three-wire system. From the applications for current already received, it is evident that the undertaking is meeting a want which has been felt in the district, and that before very long the station will, under the supervision of Mr. A. E. Brooks, the Manager, justify the step the Directors have taken.

The plans and specifications were prepared by Messrs. Handcock and Dykes, of No. 1, Victoria Street, S.W., the Company's Consulting Engineers; and Mr. E. J. H. Bluett filled the position of Clerk of Works during the carrying out of the undertaking. The following are the names of the Contractors for the different portions of the plant: Buildings and foundations, Mr. Pizzey, of Ascot; gas plant, dynamos, water-tank, piping, &c., Messrs. Bilbie, Hobson, and Co. (Messrs. Hornsby and Sons, Limited); accumulators, the Tudor Accumulator Company; switchboard, boosters, and connections, the Electric Construction Company; overhead crane, Messrs. Herbert Morris and Bastert; underground mains, meters, and services, Messrs. Siemens Bros. and Co.; and station wiring, Messrs. Tyler and Freeman.

OBITUARY.

The death is announced of Mr. J. H. Lockley, a Director of the Bristol Gas Company. Deceased, who had retired to Bideford, up to some fifteen years ago took an active part in the public affairs of Bristol; and for nearly ten years was a member of the Town Council.

The death occurred on Monday night last week, at the age of 82, of Mr. John Mobberley, of Stourbridge. Deceased, in association with Mr. Henry Perry, rather more than thirty years ago founded the business of fire-brick manufacturers which has since been carried on under their names at the Hurst Works, Dudley, and elsewhere, and which a few weeks ago was converted into a limited liability undertaking. He was one of the best-known figures in the fire-brick and kindred trades in the Midlands.

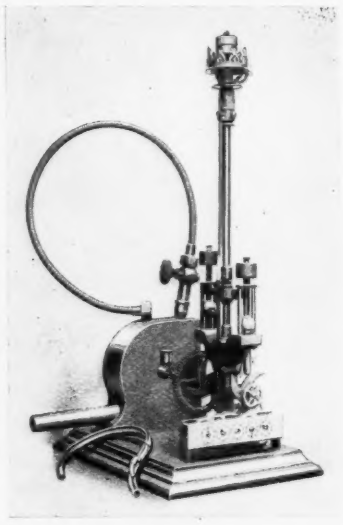
The firm of Drakes Limited have sustained a great loss by the painfully sudden death last Thursday, at the early age of 45, of Mr. John Samuel Marsland, the Managing-Director of their Ovenden works. He was in his usual health during the day, and went home to tea about five o'clock. Having gone upstairs to the bath-room before sitting down to the meal, and been absent longer than usual, Mrs. Marsland went to ascertain the cause, and found her husband lying dead upon the floor. A medical man was immediately summoned, who has certified that death was due to syncope, resulting from heart trouble. Only about a fortnight ago deceased returned from Portugal, where he had been spending his holiday, greatly improved in health. Mr. Marsland served an apprenticeship with Messrs. Laidlaw and Son, of Glasgow, and then went to Messrs. Robert Dempster and Sons, at Elland. Before he left their service he was Works Manager. In this capacity he went to Leeds, to Messrs. Clayton, Son, and Co.; and afterwards to Messrs. Drakes. This was something like eighteen years ago. A few years later he was admitted partner, and on the formation of the Company into a limited concern, he, with Mr. J. Armitage Drake and Mr. Drake's elder son, was appointed a Managing Director.

We regret to record the death last Wednesday, at his residence in Cromwell Road, South Kensington, in his 59th year, of Mr. Henry J. Robus, sole partner in the firm of Messrs. J. & H. Robus, of Norfolk Street, Strand. Deceased, who was personally known to a large number of our readers, had not been in very good health for some time; but he was able to attend to business till a few weeks before his death. His father was in the service of what was then the Crystal Palace District Gas Company, and Mr. Henry Robus's first connection with the gas industry was at the Company's works at Lower Sydenham, under the late Mr. E. S. Cathels. When this gentleman was appointed Chief Engineer of the Montreal Gas Company, Mr. Robus accompanied him to Canada to assist in carrying out the extension of the works. After two years' absence he returned to England, and in 1873 the business with which his name was identified was started. Beginning with the erection of retort-settings, the firm gradually extended their operations until they embraced the carrying out of contracts for the entire construction of gas and water works. Among these may be mentioned the works at Goring and Streatley, of which the late Mr. Jabez Church was Engineer. The Company formed to carry out this undertaking developed into the South Oxfordshire Water and Gas Company, of which Mr. Robus was Chairman; and it was only in July last that he presided at the inaugural ceremony in connection with a new reservoir which had been constructed by the Company. Mr. Robus was a Freemason, and a Freeman of the City of London—having been a liveryman of the Worshipful Company of Blacksmiths. He was likewise upon the directorate of several companies. He leaves a widow and a large family. Two of his sons (Mr. G. H. and Mr. F. C. Robus) have long been associated with the business.

A NEW MANTLE TESTING MACHINE.

With the idea of meeting the needs of those who desire to test mantles not only for strength, but also in regard to their capacity for resisting the strain caused by repeated lighting and extinguishing, Messrs. Harold W. Woodall and P. G. Moon have designed a cheap and portable apparatus which they claim satisfactorily answers the requirements. The Sole Licensees for the supply of the appliance are Messrs. Thomas Glover and Co., Limited, of No. 49, Queen Victoria Street, E.C.

The accompanying illustration shows the machine, which, it may be explained, consists of a brass standard, wherein is formed the body of a cock, the plug of which carries at the end a spur tooth-wheel. On each end of this plug-spindle is carried a four-tooth cam-wheel, set in such a manner that the cams on either end of the spindle are not exactly opposite each other. On the top of the standard are fitted two pairs of uprights, in which are arranged two spindles that are free to rise and fall, carrying at the lower end hardened steel rollers, which engage with the cams; and on the top of the spindles allowance is made for fitting various sizes of weights. On the top of the upright column is fitted a long tube, having at its lower end a cross-piece, which is fixed to the tube, and on which the sliding spindles carrying the weights are free to drop when the plug (and consequently the cams) are revolved. By this means, a succession of shocks, numbering eight for every revolution of the plug-spindle, are transmitted to the cross-piece, and so through the long upright pipe to the burner and mantle. In addition to this, as the plug revolves in the body of the cock the gas is alternately lit and extinguished; thus subjecting the mantle, as far as possible, to the conditions which would be met in actual service. That is, the mantle is continually receiving shocks, the intensity of which can be varied according to the weight put upon the spindle; while it is at the same time lighted and extinguished—the lighting being effected by means of a small bye-pass parallel to the upright tube. On one end of the spindle carrying the cams is fitted a wheel, which is in gear with the train of wheels of the index, for the purpose of ascertaining the number of revolutions. The hands of this index are socketed in order that they may be set to zero after each test. The apparatus is sent out with two upright standards—one being for testing inverted mantles, the other for the ordinary "C" mantles; and it can be fitted with any form of burner desired to enable any type or size of mantle to be tested.



Woodall and Moon's Mantle-Testing Machine.

The tester can be driven by any form of motor; but in the type illustrated a small water-wheel, specially designed and made, has been adopted as the simplest manner of obtaining the necessary power. To this is attached a cock and a piece of flexible pipe to allow of connecting to any convenient source of water supply. No connection has been supplied on the outlet, as it is preferable to allow the water a free exit. The speed at which the apparatus is driven can be easily regulated by means of the tap fitted to the inlet of the motor. It is stated that about 30 revolutions of the spindle per minute give the most comparable tests. Comparing results, care must be taken to see that they have been obtained at approximately the same number of revolutions per minute of the spindle.

The following is the method of testing mantles: The burner is attached to the machine, and the mantle placed on it. The cock is then turned round to such a position as to admit gas under the mantle, after which the mantle is lit and allowed a short time to harden. After this is done, the hands of the index are set to zero, and the machine is started. It is then run with the light weights on it, and observation kept of the mantle to see when it shows signs of breaking. Should the mantle stand the test with the light weights, it will be necessary to put on successively heavier ones until the most satisfactory weight for testing the mantle is arrived at. It will, it is stated, be found that weights of about 2 oz. are the most satisfactory for general use. Mantles can be tested to destruction with the shocking and lighting and extinguishing simultaneously, or the gas can be extinguished and the machine used only for giving shocks to the mantle; or the shocking arrangement can be put out of gear by propping up the spindles with the heavy weights.

MIDLAND ASSOCIATION OF GAS MANAGERS.

The Autumn General Meeting of the Association was held last Thursday, at the Grand Hotel, Birmingham. The PRESIDENT (Mr. Hubert Pooley, of Stafford) was in the chair; and there was an excellent muster of members.

The HON. SECRETARY (Mr. Charles Meiklejohn, of Rugby) read the minutes of the last meeting; and they were confirmed.

DISTRICT REPRESENTATIVE ON THE COUNCIL OF THE GAS INSTITUTION.

Mr. VINCENT HUGHES (Smethwick) moved that the President be elected district representative on the Council of the Gas Institution; remarking that he did not think the members could have anyone better than Mr. Pooley to serve them.

Mr. W. LANGFORD (Longton) seconded the motion; and it was unanimously agreed to.

The PRESIDENT, in acknowledgment, said that he was deeply sensible of the honour the members had conferred upon him in electing him as their representative on the Council. He need hardly say he should endeavour in this position to do all in his power to forward the interests of the Association and of the industry generally.

NEW MEMBERS.

The PRESIDENT said the following gentlemen had been nominated as members of the Association, and their names had been passed by the Committee for recommendation to the members: Mr. Edward Jones, of Burslem; Mr. Thomas Oswald, of Bolsover; Mr. James R. Duff, of Banbury; and Mr. F. J. Bywater, of Saltley. He proposed that the recommendation be adopted.

The proposition was unanimously carried.

Mr. W. C. JONES (Brierley Hill) then read the following paper on the

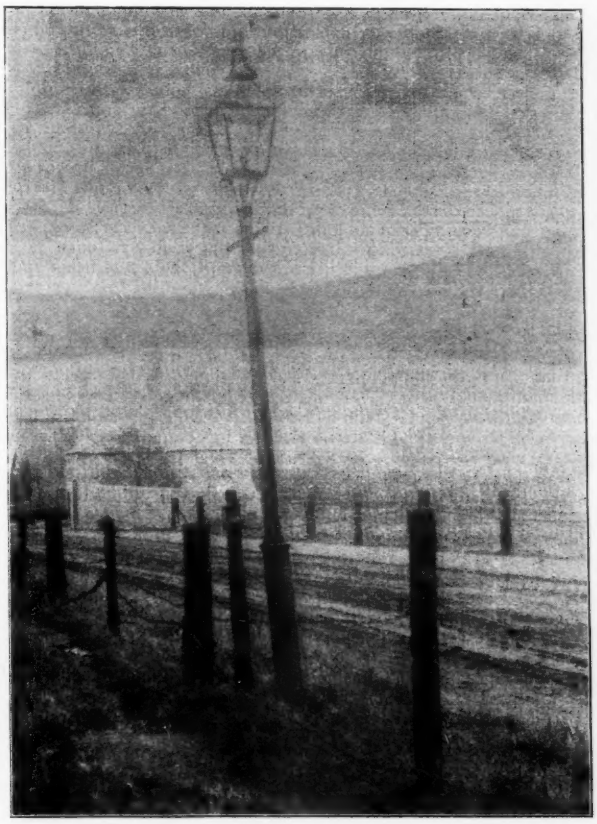
MAINTENANCE OF MAINS IN A MINING DISTRICT.

The subject I have chosen is one which I am afraid will not be of general interest to the members of the Association; but to those who, like myself, have charge of a district that is undermined with coal workings, I trust it will be of some little use. I hope that it will promote discussion, and that members will give the results of any experience they may have had in maintaining mains under similar circumstances.

The district supplied by the Brierley Hill Gas Company is situated over part of the south-western portion of the South Staffordshire coalfields, and also over what is known as the Pensnett Chase. As most of you are doubtless aware, these coalfields are without parallel in the country, owing to the fact that there are in them six workable seams of coal, of a total thickness of about 65 feet. The most remarkable one contains the "10-yard" or "thick" coal, which underlies a large area at an average depth of 120 yards. Above this seam, at a distance of about 40 yards, there is a 4-foot seam of Brooch coal; and it is the working of these two seams that causes the subsidence of the surface of the roads.

In parts of the Brierley Hill district, we find that the thick coal, instead of being 120 yards, is only 60 yards below the surface. In addition to this, the owners of the mines have the absolute right on Pensnett Chase to work the mines in such a way that, no matter what damage is done to property on the surface, they are not responsible. You will therefore readily understand that the coal is mined in the cheapest way possible; and as a consequence, the surfaces of the roads very often sink from 12 to 18 feet in as many months. By the kindness of Mr. J. Lewis Harpur, the Engineer and Surveyor to the Brierley Hill Urban District Council, I am able to put before you plans and sections of two different roads, which show very clearly the subsidence that has taken place.

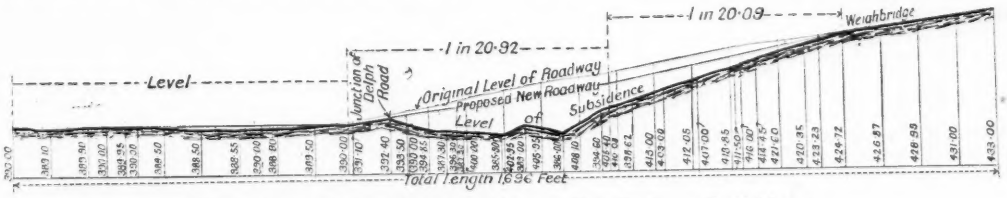
In the year 1900, the pillars were being taken out of the 10-yard coal just outside our works. About 400 yards of 6-inch main was laid in the horse road over the ground that was sinking; and we kept repairing this main day and night. While we were engaged in mending one break, we have heard the main break in other places, and have seen the footpath sinking and the paving



Illustrating the Effect of Subsidence on Gas-Lamps at Brierley Hill.

[Observe the short length of lamp column remaining above ground next to the full length standard.]

bricks form an arch near where we were standing. After a week or two of this work, I obtained permission to lay a 6-inch main on the surface of the road. This was done; and as the ground kept sinking, we lifted our pipes and kept the joints well caulked. About the middle of this sag we had a gas-lamp fixed, and after lifting it out of the ground twice—about 3 feet each time—I fixed 6 feet of 6-inch main on the underside of the column, and allowed it to remain as a landmark. You will see from the photograph the position of the column to-day. In another district, practically



Section of Road showing Mining Subsidence on Main Road near Brettel Lane.

all the houses were let down. During the time this was going on, we had fixed at the entrance to the district a 500-light dry meter, through which all the gas was passed. The registration was taken every morning, and the consumers' meters were all read weekly. This gave us some indication of how things were going on.

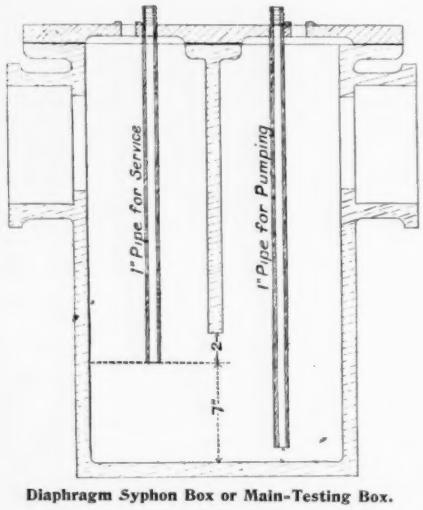
From the Brierley Hill works, owing to the great difference in altitudes, we have five trunk mains—a 12-inch and four 6-inch—running into the district. They are controlled by four 10-inch Parkinson governors. The mains are necessarily laid very near the surface of the road, and, having been disturbed and lifted so often, some of the joints have only an inch or two of hold. They are consequently not in an ideal condition to stand much more disturbance. They are all cast-iron socket and spigot pipes, with open lead joints. For the purpose of maintaining such a distributing system, and keeping the leakage of gas within reasonable bounds, the following methods are adopted: Every morning, as soon as it is daylight, four sets of men, with probing bars, are sent into the district. They prick the ground every few yards along the side of the mains, and then apply a lighted torch to the hole. If gas is found in only one or two places, they repair at once; but if, as often happens, gas is found along the whole length of a street, more men have to be sent to get the ground out as quickly as possible.

Wherever the ground is solid and compact, and our mains are not less than 9 inches below the surface, I have found Ansell's leak indicator a most useful instrument. When using it, we first drive the bar into the ground by the side of the main, and after loosening it by a few taps with the hammer, the ground around the bar is rammed solid, and the bar carefully withdrawn so as to leave a clear hole, over which we place a soft rubber washer cut

to the size of the bottom of the indicator. On the washer we put the indicator with the tile over the hole, then turn off the tap, and watch the dial. This operation we repeat until we get the maximum indication on the dial, then at that spot we open down to the main, and are usually not a long way from the leakage.

In addition to the foregoing regular inspections, we make some periodical tests on each main with the aid of test-meters. For this purpose we have valves fixed about 600 yards apart on most of our mains. Where we have not any valves, we adopt the following method to make a sectional-test: At the supply end of the section of main we wish to test, we drill five holes; the two outer ones ¾ inch diameter, and the next two of sufficient size to allow a bag or bladder to be passed through. The middle hole may be ½ inch diameter. To the two outer holes stand-pipes are fixed, to each of which is attached a dry test-meter. Ours is a 20-light meter, and shows on a large dial the quantity of gas passing down to the hundredth part of a cubic foot. Into the next two holes we pass bladders for all sizes up to 6 inches diameter. These are then inflated in the main, and thus stop the passage of the gas. But to make quite sure that no gas is getting past them, we fill the intervening space with water through the middle ½-inch hole. At the other end of the section of the main we are about to test, we in like manner bag off the other part of the main, also all branch mains are similarly bagged off. During the making of these preparations, a man has been to every consumer's service, and has shut off the main cock. It is not sufficient for the man to call and ask them to do this; he must shut the cock himself, otherwise very misleading tests may result.

When all is ready, the gas is sent through the test-meter, and observations taken of the quantity passing. If it is found that this is high, the main is bagged off every 100 yards, and further observations made on each section. The following are the figures of a test of about 400 yards of 6-inch main in the early part of the present year. The first test, over a distance of about 440 yards, showed 300 cubic feet per hour; the second, over about 300 yards, 205 cubic feet; the third, over about 100 yards, 45 cubic feet. Having obtained these particulars, we started to open the main and the services at the end where the maximum amount of gas was passing per hour; and we found that the leakage was principally from each joint, which had been drawn more or less. I may add that this section of main was overhauled in August last year.

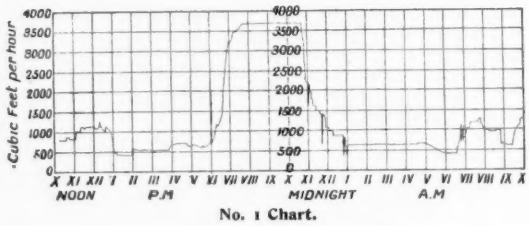


Diaphragm Syphon Box or Main-Testing Box.

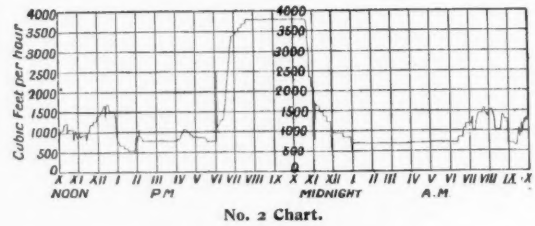
Instead of valves or bladders, we are now using diaphragm syphon-boxes whenever we have any new main to lay. These are a very great convenience, and enable a test to be made in a very short time and with the minimum disturbance of the roads. The box I am using is of the section shown above. The mid-feather wall or diaphragm is kept about 9 inches from the bottom, which allows sufficient room for the collection of condensation water. You will notice that there are two pipes—one within an inch of the bottom of the box, and the other 2 inches below the diaphragm bottom. The first pipe is for emptying the box, and to the second we attach the nearest service available. This service acts as a safety indicator, and gives warning of any accumulation of water between the regular pumping periods. There are two plugs arranged for the purpose of attaching the stand-pipes for the test-meter. It will be readily seen how easy it is now to have all ready for testing in a very short time. All that is required to stop the gas is to run water into the box until the diaphragm is covered.

In addition to these methods of detecting leakages, I have recently fixed one of Messrs. Thorp and Marsh's diagrammatic meters, which are constructed to show upon a diagram the quantity of gas passing at any moment. The charts are changed every morning, and compared with the one taken the previous day. If it is found that the draught varies from the preceding chart through the hours of (say) 1 a.m. and 4 a.m., the conclusion would be that a main or mains had broken. Diagram No. 1 is a reproduction of the first we took with our meter. It will be observed that between 10 a.m. and 1 p.m. the quantity of gas passing varied from 800 to 1200 cubic feet per hour. There was then a drop between 1 p.m. and 2 p.m. to 450 cubic feet, increasing to 700 cubic feet during the afternoon. At 6 p.m., a considerable rise took place, until about 8 p.m. the consumption reached its maximum of 3800 cubic feet per hour. It remained at this point until about 10.40 p.m., when it decreased until at 1 a.m. the flow was 650 cubic feet, falling again to 400 cubic feet as the lamps were extinguished, and then rising again between 6 and 7 a.m. as the gas-engines, &c., were set to work. I may add that after we had had the meter in use for a week or two, we always obtained a straight line during the hours of maximum consumption. I carefully watched the meter, and found that the float was a little stiff when it was high, and that it did not respond as quickly as it should have done to the varying consumptions. But by a little adjustment this was put right, and the charts we now obtain show a gradual drop after the maximum has been reached.

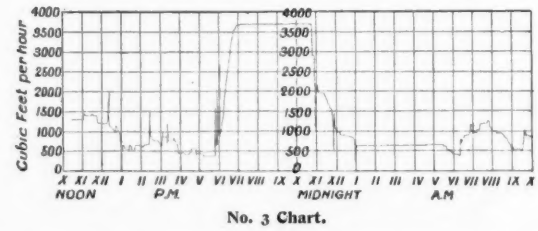
Diagram No. 2 is a reproduction of the second record taken. I may point out that between the hours of 1 and 5 a.m. the consumption went up to 700 cubic feet per hour; but in two days it increased to 750 cubic feet per hour. We then discovered the leakage, which was caused by a broken 6-inch main. After repairing the main, the next record showed us that during the same hours the consumption had again fallen to 650 cubic feet or less per hour. I am of opinion that the extended use of these meters will prove a valuable means of detecting leakages as they occur. The meter consists of an outer iron case and an internal



No. 1 Chart.



No. 2 Chart.



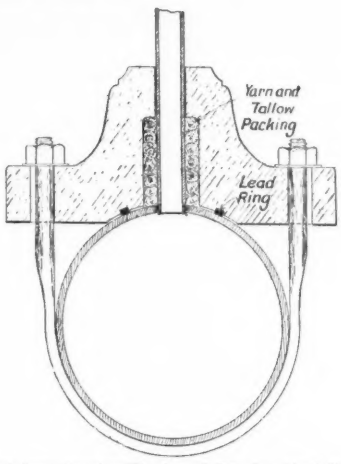
No. 3 Chart.

conical tube, in which a circular disc is free to move in a vertical direction. To the disc is attached a vertical rod, which at its upper end carries a capillary pen, which records upon the revolving drum paper the extent of rise and fall of the disc, and consequently the quantity of gas passing through.

Having occasion to lay about 700 yards of 8-inch main this year, I decided, after careful consideration, to recommend for the purpose Mannesmann tubes, which, you are doubtless aware, are made from a solid block of very mild steel—there being no seam or joint throughout the length of a pipe. They are very flexible and elastic—in fact, the makers claim that the tubes are unbreakable. The length of each tube varies between 25 and 36 feet. It is a very easy matter to mark the position of each joint on the Ordnance map; and therefore there will be no difficulty in finding the place at any future time. Against these advantages were to be placed the fact that the thickness of an 8-inch pipe was something under ¼-inch; and the durability of a steel main in ground such as we have in our district—it being composed largely of ashes, and being very destructive to any kind of iron—was a matter for serious consideration. In order to minimize the risk of corrosion as much as possible, the tubes are protected by a special preservative solution applied while hot to the pipe both inside and out. The outside is still further protected by being wrapped in a special jute cloth. It is claimed that this coating renders the metal proof against corrosion in any kind of ground; and, from information I was able to obtain, I came to the conclusion that the pipes would last at least as long as those of cast iron. This, of course, can only be proved by time.

With regard to the thickness of the mains, I did not think that

the pipes were thick enough for drilling and tapping service connections without some kind of support, though the makers claim that the thread made in the steel main is of greater strength than that obtained in an ordinary cast-iron main. However, in our district it was not considered that this would be sufficient to stand the strains that would be put upon the pipes; and therefore I designed a service clip which I think will make a strong connection to the main and will also allow of the service breaking at the junction, and still remaining gas-tight. The clip is shown in the accompanying diagram.



Cast-Iron Service-Block and Clip for Steel Main.

To make a service connection, we first drill and tap the main, then through the clip we pass a connecting-piece, and pack the gland with spun rope yarn filled in with Russian tallow. This is packed in as tightly as possible, and left to project about 1 inch beyond the face of the block. A cast-lead ring is placed in the groove of the block, and the connecting-piece screwed into the main in the ordinary manner and made perfectly gas-tight. The block is then drawn tightly down to the main with a strong wrought-iron clip, and the whole is covered with jute cloth and the preservative compound. We find that on the cast main the junction of the service to the main is the weakest spot, and that when the ground moves it gives way here sooner than at any other part of the service. This clip will, I hope, prevent the large leakage we often have at this point. The blocks are made large and deep; but this is to allow of the service being drawn at least 1½ inches without leaking.

Having satisfied myself that all the disadvantages of steel mains could be overcome, the next question was that of cost. This I estimated would not be any more than cast iron; and, as a matter of fact, it came out rather less. All the joints on the main were made with lead wool; the form of joint adopted being a double collar of lead with spun yarn between. This form of joint gives exceptional strength, and allows of the joints drawing apart to some extent, and still remaining tight.

On May 18 last, in the "Gas World" there was an article on "Unbreakable Mains and Unleakable Joints," by "K. P." The writer described a rigid joint; and I think that in any future extension of these mains I should favourably consider this particular kind. There is one thing on which I cannot agree with the writer, and that is where he says that by the appliance described one can make the joints on the outside of the trench, and put the pipes in as roughly as one pleases. It may be true that the joint will remain tight; but I am afraid the jute protection that is put round the pipes will be damaged. If this occurs, and the damage is not repaired, undoubtedly corrosion will take place quickly, and then steel mains will not possess the advantage the writer claims for them.

With regard to lead wool for jointing purposes, I tested with hydraulic pressure the 700 yards of pipe we laid. We raised the pressure to 55 lbs. to the square inch, and left the pipe under this pressure for about fourteen hours. At the end of that time, it had lost 10 lbs., which we found was due to the syphon-cover joints. In addition to this test, I had a series of tests made at the works, to show the comparative strength of lead wool and cast lead. We joined up three lengths of old 3-inch cast main pipes, with caps on each end—one set being jointed with lead wool, and the other with cast lead. After jointing, the pipes were placed across two supports at each end, and the hydraulic test was applied. The first set tested was that jointed with lead wool. The pressure was gradually raised to 400 lbs. to the square inch, at which pressure the joints remained quite dry. Three men then placed their combined weight upon the middle of the pipes, and deflected them as much as possible—swinging at the same time. But even after this treatment the joints showed no sign of leakage. Four more men then added their weight to the others, and still there was no sign of leakage. But when they commenced to swing, the pipes broke in the middle. Two of them were tested, the pressure being raised to 850 lbs.; but the joints were quite dry, and showed no sign of drawing. On trying to raise the pressure still further, the pipes burst. The set of pipes jointed with cast lead was next tested; but, unfortunately, when 300 lbs. pressure was reached, one of them burst. Two of the pipes were then joined, and the pressure raised until 800 lbs. was reached, at which pressure one of the pipes began to draw out of the socket.

I next had the joints broken open, and the weight of lead and yarn ascertained. I found that in the cast-lead joints we had used 3 lbs. of lead and 3½ oz. of yarn; and in the lead-wool joints, 1½ lbs. of wool and 6¾ oz. of yarn. The comparative cost of the joints was therefore as follows:—

Cast lead, 3 lbs., at 2½d. per pound	7d.
Yarn, 3½ oz., at 3d. per pound	¾
Total cost of joint, less labour	7¾d.
Lead wool, 1½ lbs., at 3½d. per pound	5¼d.
Yarn, 6¾ oz., at 3d. per pound	1½
Total cost of joint, less labour	6¾d.

With regard to the labour required in making a lead-wool joint, it is undoubtedly harder work, as the man has to caulk the joint solid from back to front. But I do not think any more time is expended, because with lead-wool jointing no time is wasted by the jointer waiting for the ladle of lead to be brought—the lead not being at quite the right temperature. There is no chance of blown joints; and a man is not required to wait on the jointer. Independent of the cost of fires, I am quite sure that the expense of a lead-wool joint is less than that of jointing with molten metal. I have here a ring of the lead wool that I cut out of the joints referred to in the tests.

The question of services in our district is a very difficult one, not only on account of the movement of the roads, but of the fact that the soil is composed to a great extent of ashes. A plain wrought-iron gas service-pipe would not last three years in many parts of the district. We have tried lead services; and while they are very good in some respects, they are not in any way ideal services. They certainly allow more movement than those of iron, without causing a large leakage of gas; but I have found that in many of the services which have been laid for a number of years slight leaks are found to be taking place at the points where the lead has stretched and been bent with the movement of the road. In some cases, the lead is cut very slightly by some hard and sharp piece of clinker or flint. It is true this does not cause great leakage; but I prefer a large leak to a small one, as the large ones are easily found and repaired, whereas it is the small ones that cause the great loss of gas we experience. We use steam tubing of extra strength for all services, and paint it with a well-boiled mixture of tar and lime. The mixture we use is made by adding about 1 lb. of sifted lime to each gallon of tar. This is added to the boiling tar and thoroughly mixed; and it is further boiled until the mixture is like thick syrup when cold. After the pipe is painted with this mixture, it is covered with jute cloth and given another coat of the tar preparation. A pipe coated in this way will, I believe, be effectively protected from corrosion; and the covering possesses the further advantage of being flexible, and allows of the bending of the pipe without destroying its protecting coat. Before adopting this method, we buried our pipes in good soil, which we had to cart to each job where we thought it was necessary.

The foregoing are a few of the methods we adopt to maintain our pipes and services, and keep the leakage within reasonable limits. The most important thing, however, is the constant supervision that has to be given, for without this all the other precautions are of very little use. I have said nothing as to whether or not I believe in high or low pressure distribution for a mining district. But I will say this, that I consider the pressure should be sufficient to give to the consumers all the gas they require. For this purpose, it is necessary in the district of Brierley Hill, owing to the great difference in altitudes, to have initial pressures ranging from 15-10ths to 45-10ths. It will be understood how the levels vary in the district when I mention that some time ago we had three or four lamps acting as water fountains, when the lamplighter opened the cocks, owing to both the water and the gas mains being broken.

You will now probably want to know something regarding the cost of the system of maintenance described, and the results obtained with it. The cost is necessarily very high, and has averaged during the last ten years £900 per annum, or between 2s. 6d. and 3s. per ton of coal carbonized. We repair every year between 1100 and 1200 leaks caused by joints being drawn and mains broken. Our unaccounted-for gas during the last ten years has been, on an average, 14·7 per cent. of the make. Seven years ago it was as high as 16·1 per cent.; last year it was 13·9 per cent.; and the lowest was in 1905, when it was down to 13·2 per cent. Our loss last year was equal to 452,640 cubic feet per mile of main, or 51·6 cubic feet per hour per mile. We sold 2714 cubic feet of gas per mile of main, and 10,467 cubic feet per ton of coal carbonized.

In conclusion, I would emphasize the importance of maintaining the pipes and services in as perfect a condition as possible, for money spent on this object is well spent. I would also urge that every means tending in this direction—whether it be diagrammatic meters, lead wool for jointing, or steel mains—should receive the careful consideration of all gas engineers.

[The author had brought for inspection by the members one of his cast-iron service blocks and clips, attached to a small piece of Mannesmann 6-inch pipe. The pipe also showed the ordinary spigot and socket made on each pipe. There was likewise part

of a 4-inch cast socket which had been recently broken through the subsidence of the road, and it showed how the piece had been forced out of the socket by the spigot of the next pipe. There was a sample of lead wool cut out of the joints referred to in the tests; also one of Short's improved leak indicators, a number of charts taken on the diagrammatic meter, and several interesting particulars of exhaustive tests made with lead-wool joints.]

Discussion.

The PRESIDENT remarked that they had listened to a paper of considerable interest; and he thought there should be a good discussion upon it.

Mr. A. T. HARRIS (Market Harborough) said that, having had charge of a district affected by subsidence, he could sympathize with Mr. Jones, in the difficulties with which he had had to contend. There was no doubt that, with improved apparatus in works, it was an easy matter to make gas; but it was more difficult to keep it in the mains in such a district as that of which Mr. Jones had charge. One point that had struck him very forcibly about the paper, and with this he was rather disappointed, was as to the means the author had taken to keep the gas in the mains. Mr. Jones told them how he endeavoured to detect and locate leakages; but, excepting what he had said with regard to his wrought-iron service clip and the lead-wool joints, he did not inform them as to the means he took to prevent these constant breakages. In his (Mr. Harris's) old town of Droitwich, they suffered very much from the same kind of thing. Some twenty years ago, he adopted two half-clips for each service, but did not have the rigid joint that Mr. Jones had in his mains. The author tapped his services in his main and in case of any strain coming upon it, there was the liability of the main being fractured, and a piece being broken out. It would be better if Mr. Jones had a little more flexibility in his joint. In his experience at Droitwich, in the event of expansion and contraction of the service, the putting of the clip over the hole partly obstructed the supply of gas, and that was their first indication that something was wrong. He adopted in the services what he might call a U piece of lead, laid sideways to prevent any deposit of water. These were covered over with pieces of plating, and allowed of expansion and contraction as the case might be. This arrangement was found very useful and beneficial. He also adopted cone metal expansion joints; but cost prevented their general use. In Mr. Jones's case, he must have a considerable amount of expansion and contraction; and he (Mr. Harris) could not understand why expansion joints had not been adopted by him. In his own case he used them with great success, and found them very advantageous. He also adopted a long socket joint; a socket being cast on the pipe about 12 inches long. They only got about 3 inches of spigot in the socket; so that they had about 9 inches in the joint to allow the pipes going together without bursting the sockets. They fixed them *vice versâ* in case of expansion. He should like to ask Mr. Jones whether he had adopted any means other than the searching for leaks for preventing the troubles experienced. It appeared to him that the expenditure of some hundreds of pounds would be beneficial at Brierley Hill in putting in a system of joints which would prevent this constant examination; and he did think a lot of the labour could be avoided.

Mr. GEORGE HELPS (Nuneaton) said that he used Mannesmann tubes some five years ago. He put in about 3 miles of pipes with open joints made with lead. Having seen these tested to 1000 lbs. per square inch water pressure, he thought he was perfectly justified in using this joint for ordinary gas pressure. He put the mains in, and tested them to 60 lbs. per square inch air pressure; but when they had been in a short time, every joint leaked. It took him a good while to discover what caused this. He jointed up some of the pipes above ground, fixed a gauge on them, and tested them up to 40 lbs.; and they stood perfectly well. He started hammering the pipes, and did not see any leakage at first; but, after repeated hammering, and so subjecting them to continued vibration, every joint began to leak. He came to the conclusion then, and he had never since modified it, that lead, being compressible, was not suitable for a joint, however one used it. A main might be tested when it was first put in, and show itself perfectly tight; but after being subjected to repeated vibration, the joints would leak. He did not think there was any remedy for this except a screw joint; and he should recommend Mr. Jones to try screw joints, with at intervals expansion joints, in his mains at Brierley Hill. As to pressure, Mr. Jones said in his case it varied from 15-10ths to 45-10ths. 15-10ths was very low; 45-10ths was reasonable. (Laughter.)

Mr. T. CROSS (Cannock) remarked that he had the superintendence of a district similar to that described by Mr. Jones; and one part of it was very bad through mining operations. He recommended his Directors to try some of these Mannesmann pipes; and about four or five months ago, they laid 500 yards of the 8-inch size. Since then they had only found two leakages in the 500 yards. They had about 25 miles of main; and only made about 55 million cubic feet of gas. In the 25 miles of main, they had six different sections undermined. From this the members would quite understand that he had some difficulty, and that he could quite appreciate Mr. Jones's paper. He had a report by Mr. Thomas Newbigging made at the time when they were about to amalgamate two different companies, of one of which he (Mr. Cross) had charge. The report was made ten years ago; and in it Mr. Newbigging pointed out that, though the districts were both undermined, one of the Companies had only 5¼ per cent. loss, while the other had 30 per cent. Now this was not due to the fact that the latter district was not looked after properly. It was because, when the mains were first laid in this mining district, they were put in with turned and bored joints; and most of the members would understand the effect of this would be that, as soon as there was a little subsidence, the sockets would split. He had found a socket split into eight pieces on a 6-inch main. Mr. Jones mentioned a syphon that he had put in, with a division-plate in it. He had tried syphons in his district; but when the side of the syphon was completely pushed in, the syphons had very little effect. This had happened to him only in the last two months. It was in a 14-inch main, in which he put a syphon, so as to allow the pipes to push in or out as the case might be; and this acted as an expansion joint. So far as the Mannesmann tube was concerned, in addition to the jute, he had covered it with tar and then with soil. This, he thought, would assist in protecting the pipe. He emphasized the point that turned and bored joints were all right in some districts, but not in a mining area. As to service-pipes, Mr. Jones said he often found them drawn; and Mr. Helps suggested that they should be threaded. In one length of some 200 yards of main, he found the services drawn in about four places; and this would have been a very serious matter if the pipes had been in any depth of ground. The 500 yards' length of 8-inch steel main to which he had referred was laid under the footpath and as close to the surface as he could get it; and up to now they had only had two leakages on the whole length. He therefore thought steel tubing was a step in the right direction in a mining district.

The PRESIDENT remarked that the members were grateful to Mr. Jones for reading this interesting paper. It did not, fortunately, fall to the lot of all of them to control distribution systems in such difficult districts as that with which Mr. Jones had to deal. The paper was a good contribution to the annals of the Association, and would prove useful to those who came after them.

Mr. JONES, in responding, expressed his thanks to the members who had taken part in the discussion. Mr. Harris had said that he (the speaker) had not told the members how to prevent leakages. He was sorry he had to admit he did not know how to prevent them. He had tried every imaginable form of expansion joint that had been brought to his notice; but the difficulty was he could not get them put in at the right place. If he put in an expansion joint one day, it was certain the pipe would be broken the next day about 20 yards away from the expansion joint. So that he could not possibly determine exactly where to insert the expansion joints. He illustrated one instance where the Brooch coal was being mined underneath a roadway, in which there was a 10-inch pipe; and in that road practically every joint had gone, so that an expansion joint would have had to be put down at every connection. In another place at the same time, they had a 6-inch main broken in two places. The difficulty, therefore, would be to find where to introduce the expansion joints, even assuming they were all that was claimed for them. On one main some years ago, they inserted several expansion joints; and for a considerable time this particular district was perfectly quiet. For some reason or other, the mines that it was thought were going to be worked were not for a year or two. By the time they were worked, the expansion joints were of little use; and then it was found they were worse than the open socket pipes. Mr. Harris also found a little fault with the clip; and he (Mr. Jones) quite agreed that on a cast-iron main, it would be a disadvantage to screw it on to the main. He thought rather than screw the pipe into the casting, he would simply bore the gas-main out, and fit the end of the service flush against it, and then screw the clip down on to it, so that it would be flexible. In the case of the Mannesmann pipe, it would be impossible to break a piece of the main out with the clip.

Mr. HARRIS said he understood Mr. Jones used it on cast-iron mains.

Mr. JONES replied that it was only on the steel pipe that he used the clip. Mr. Harris also suggested a piece of lead between the main and the service. He had tried lead as well; but his objection to lead was that it so often got cut, and he frequently had leakages taking place through it. They had special troughs of earthenware made in which to lay the lead pipes, so that they would not get cut. But the troughs got smashed; and they found the gas leaking again. Since then he had preferred to stick to wrought-iron services. He might say that what he had done, and still did, in a number of cases was to lift a main entirely out of the ground, and let it remain on the surface of the road, so as to examine the joints every day until subsidence of the ground had finished, and then he had the main relaid. He had been given notice by the mining engineer to the Earl of Dudley that, during the next two or three years, they were going to take out the 10-yard coal; so that there would be constant breakages along the particular road that would be affected. Mr. Helps referred to the Mannesmann pipes and the joints. He (Mr. Jones) did not gather whether the joints in Mr. Helps's case were of lead wool or molten metal joints.

Mr. HELPS: Molten metal.

Mr. JONES said he could understand that molten lead would not stand the vibration. A molten lead joint was only caulked a little on the surface of the joint; but if the joint was made of lead wool, it could be caulked right from the socket at the back to the front. He thought a joint of this description would not suffer from the vibration of which Mr. Helps had spoken. He knew that Mr. Cross had a district very similar to his own, and

had much the same experience. Mr. Cross said that syphons were of little use when the ends of the pipes were pushed in; and he quite agreed with him in that. In places where the mines were being worked, he should not put in a syphon—at any rate, for the time being. He agreed that, in addition to the jute covering of the Mannesmann pipes, it was a good thing to give them a coating of tar; but the pipes must be first carefully examined to see whether the jute cloth was damaged by travel. If so, it must be repaired. He was also convinced that turned and bored joints were of no use in mining districts.

Mr. M. KAHN (London) then delivered a lecture from which the following is taken:—

REINFORCED CONCRETE AS APPLIED TO GAS-WORKS.

Reinforced concrete has already been so widely used in England that it would seem superfluous to go into the origin and early history of this class of construction. It is assumed that all engineers are more or less acquainted with its underlying principles. My object is to bring out the comparative merits of this and other systems, and to show why it should be more generally adopted.

Reinforced concrete is permanent and entirely proof against the deteriorations to which other materials are subject, such as the rusting of steel, the rotting of woodwork, and the decay of stonework. It is unaffected by atmospheric action, and from this point of view is equal to stone of best quality; and when properly floated immediately after construction, it is impermeable. Finally, it is absolutely fireproof; and what is most advantageous about it is that its strength increases with age. The ease with which the necessary materials may be obtained in almost any locality makes possible a rapidity of erection not attainable by other methods, especially in ordinary steel construction, where delivery is so uncertain.

A reinforced concrete structure, being cast as a monolith, is much more rigid than steel, where absolutely firm connections can only be secured at great cost. It can be made as strong as steel and just as elastic in its action. One would think that a reinforced concrete girder could not deflect without cracking. I will show you a test which was carried out on a reinforced concrete floor slab. The beams were 16 feet spans, carrying a decking of similar span. The floor was loaded up to 2 tons per foot super; and under this tremendous weight the deflection of the beams was only 3-32nds of an inch. A steel girder could not possibly have behaved in a better manner. In spite of the deflection, there are no signs of cracks. The monolithic character of reinforced concrete makes it almost proof against violent injury from sudden shocks.

In discussing the economy of reinforced concrete, several facts must be taken into consideration. As a rule, it is cheaper than structural steel in prime cost; and it is also cheaper than brick or stone construction when we are allowed to design according to the strength of our material. At the present time, however, many building laws in England prohibit the use of thin concrete walls in place of the thick brick walls hitherto used; and under such conditions reinforced concrete is not cheaper than brick, because there is a waste of the former material. On the Continent, however, and in America, where legislative restrictions are not so onerous, one is allowed to take advantage of its strength, and there is a considerable saving in cost. The insurance premiums on these erections are reduced to a minimum where the risk is not carried by owners themselves, as is often the case. Furthermore, there is no cost of maintenance in a reinforced concrete structure, as once built it requires no future attention.

It is erroneous to say that reinforced concrete is always the cheapest type of building, for there are cases where the incidental expenses of carrying out the work, especially in a very small job, and the price of the complicated centring required, make the use of this material prohibitive. However, an engineer soon learns to recognize where it will be more expensive than steel. Personally, I contend that, though it may not in some instances be the cheapest form of construction, it is always the most economical, if all things are taken into consideration.

It is often asked whether, in the selection of materials, preference should be given to crushed stone or ballast. Engineers are wont to object to the use of ballast, on the ground that the surfaces are generally round and too smooth, unless it is crushed. It has often been demonstrated that round, smooth ballast gives just as strong a concrete as crushed stone. Probably the most tempting aggregate to gas engineers and others is cinders and coke breeze, as both of these are produced in large quantities in their works. I should not recommend the use of either cinders or coke breeze for any complicated structure. They are satisfactory for floor spans—say, up to about 12 feet; the thickness, of course, being in proportion to the load and span. But it seems to me inadvisable to use this material for beams, girders, or stanchions. There are, however, instances where cinders or clinkers are allowable, other materials being unprocurable.

With regard to the sand used in concrete, some engineers specify that it shall be clean, sharp, and coarse. I believe all these three specifications will soon be eliminated. It has often been demonstrated that sand need not be absolutely clean—in other words, if a small percentage of loam is found in it, there is no need to wash it out, as the resultant construction will be the stronger for it. It has also recently been proved that a moderately fine sand will give a stronger concrete than sharp, coarse sand. In the selection of the sand, however, it is necessary to find out whether it contains chemicals which are apt to act on the cement. Sometimes the sand is taken from beds coming in contact with impure water. Such sands contain chemicals which kill the action of the cement; and they should be condemned. Pit sand is a very satisfactory kind to use.

The handling and mixing of concrete is a feature which, to a great extent, governs its cost. Many engineers object to machine mixers; but the employment of a good batch machine mixer is advisable on every large job. When the concrete is mixed by hand, it is turned from six to eight times; but when a machine mixed is used, it is turned at least twenty times in a much shorter space of time, and at a considerable saving of expense. A good machine mixer should be specified, providing the size of the construction and the amount of concrete to be mixed warrant the expense of installing such a plant. In general, it will be found that all constructions involving less than 400 or 500 yards of concrete will be more economically mixed by hand; but larger constructions will turn out cheaper if a mechanical mixer is used.

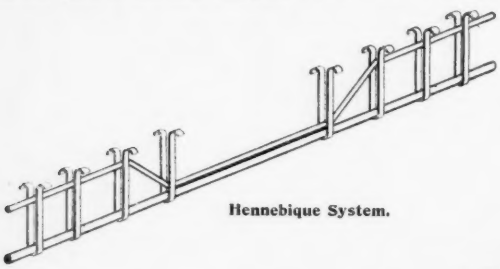
The lecturer showed a mechanical mixing plant consisting of a rotary mixer, a steam-boiler, and an engine, all mounted on a truck which enables the mixture to be discharged directly into its final position. On a parallel track runs a truck which charges the materials directly into the mixer. This plant, which was installed at a cost of less than £800, mixes and places 125 yards of concrete per day at a cost of 9d. per yard. The price of mixing and placing concrete by hand under similar conditions would have been 2s. 6d. per cubic yard. He also showed a plant used in the construction of the new works of the Bournemouth Gas and Water Company at Poole. Here the concrete was mixed by a stationary concrete mixer, and hoisted and placed by a trolley running up an incline. One of the grounds of objection to mechanical mixers is that the proportions of the materials that enter the mixer cannot be properly inspected. This objection can readily be eliminated by systematic arrangements made by the inspector or the clerk in charge. It is just as easy to use a wrong proportion in hand mixing as it is in machine mixing. But, as a rule, contractors, in their own interests, will see that the proper proportions are fed into a machine-mixer; for no one is so short-sighted as to save a few pounds' worth of cement, and incur the risk of loss due to a failure.

In discussing the subject of reinforced concrete, it is necessary to deal, more or less, with the matter of reinforcement. Originally, all the reinforcement used consisted of plain round rods embedded in the tension side of the structure. It was later discovered that certain structures failed, not through lack of sufficient tensional reinforcement, but owing to the existence of internal strains, ordinarily termed "shearing strains," which are maximum near the points of support. A properly reinforced concrete beam, when tested to destruction, should fail at the centre, or where the bending moment is greatest. Our object in requiring a beam to fail at such a point is that, in designing, we base our assumptions upon the fact that failure will occur at a certain point. Should the beam fail at some point other than that which was in view, our assumption is in error, and our consequent calculations can count for nought. Beams reinforced against tension only were found to fail by shear, as the concrete is very weak in this respect. In a test carried out by the United States Government War College, failure occurred, not at the centre by the severing of the steel, but at the ends by the shearing of the concrete. M. Hennebique was among the first to recognize this form of failure; and he attempted to overcome it by the use of U-shaped stirrups of hoop iron placed vertically round the main tension-bars, and running up into the mass of the concrete—the distance between the stirrups varying inversely to the ratio of the shear. There is no doubt that such stirrups effect a great deal of good, as they cross the planes of rupture at an angle, and tend to hold the material together. His example was followed by various engineers on the Continent, who used different adaptations of loose stirrups.

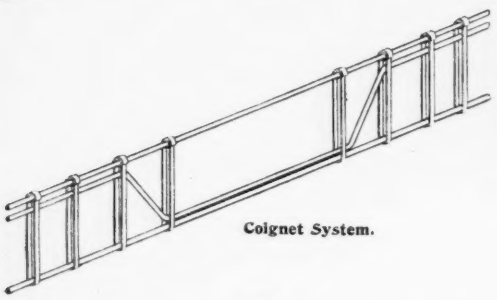
The lecturer showed three examples of reinforcement (p. 250). The first was that invented by M. Hennebique; the second was M. Coignet's method, which is to use a horizontal tension-bar in the bottom and also a small rod in the top, also loose vertical stirrups bent over the top bar; and the third was the Kahn trussed bar, wherein there is a main tension-bar on which diagonals are rigidly secured. With regard to this system, he said: A square bar is rolled with two wings projecting from opposite angles. These wings are struck up from the bar to form stirrups, but are left attached to it by means of the shoulders, which are not sheared away from the bar. In this way the stirrups are part and parcel of the main reinforcement. The bar, with its wings struck up by standard dies at the works, comes to the site ready to go into the concrete. No work need be done on it by the men, either in spacing the stirrups or in holding them in position while the concrete is placed. This entirely eliminates any error on the part of the workmen in properly placing the stirrups; for when a Kahn bar is put in position, all the stirrups must be in position, unless they are maliciously torn off. This form of reinforcement greatly relieves the duties of the inspector, as it is not necessary for him to watch the placing of every stirrup, which is probably the most complicated part of reinforced concrete work. The entire success of the structure depends upon it; so one can realize how carefully it should be attended to. The shear members or stirrups of the Kahn bar differ from both of the other

examples in that, instead of being vertical, they are inclined at an angle of 45°.

In the selection of reinforcing material, it is not necessary to go into the matter of the shape or form of the reinforcement. A plain, round rod is as good as any deformed rod. It is true that a certain element of risk is entailed in the use of the material, as unfortunately failures occur only too often. It is, however, interesting to note that most of these failures occur through ignorance on the part of the men carrying out the work; and, this being the case, careful supervision can do a great deal towards entirely eliminating them. It is not the fault of the material itself, nor is it, except in very rare cases, the result of incapable designing—in fact, I know of only one instance where failure was due to this. If, then, the cause of failures is mostly carelessness on the part of some person or persons, and if this carelessness can be obviated, it seems unreasonable for any engineer to condemn the entire field of reinforced concrete as a dangerous one.



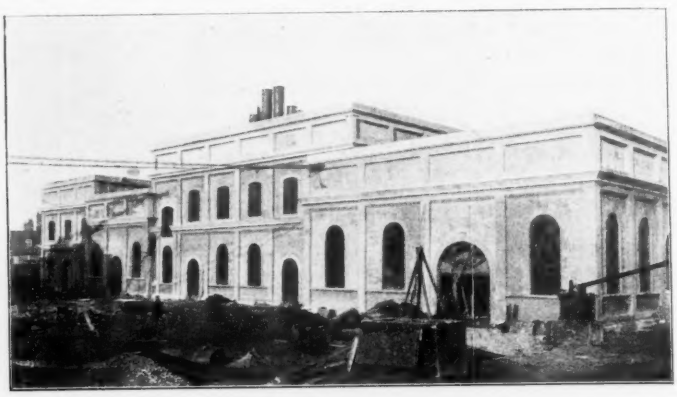
Hennebique System.



Coignet System.

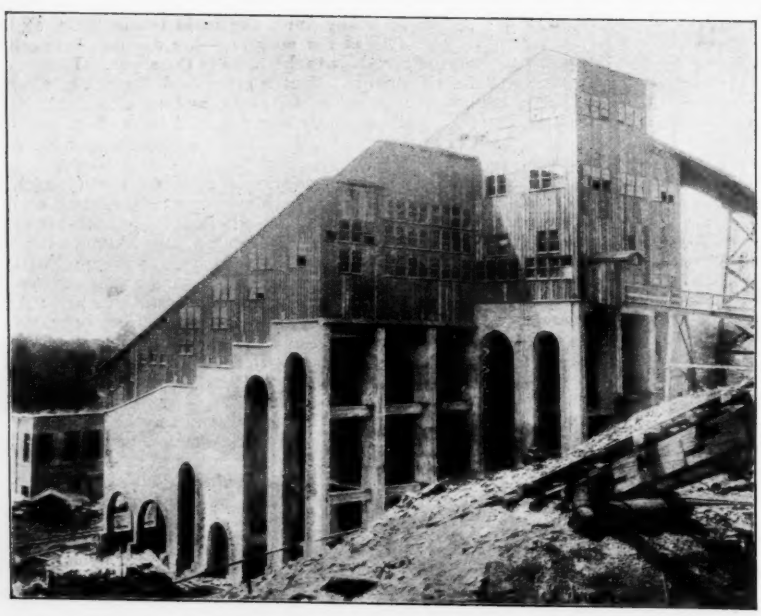
Kahn System.

The field of gas and electrical engineering offers a very good opportunity for the employment of reinforced concrete. Among the constructions wherein it can with advantage be used are: Foundations, engine-beds, power-houses, coal-storage bins, tanks for gasholders, retort-houses, coke-ovens, water towers, cisterns, and reservoirs. In all these, reinforced concrete will be found to be more economical than any other type of construction. I have here an illustration of the Pine Hill coal-breaker, which, though not having been erected for a gas company, is nevertheless of interest as showing what complicated structures can be built in the system under consideration. The coal is brought into the structure at the top, and is then crushed, screened, and passed into various bunkers, according to the size of the crushing. The building is about 90 feet high, 140 feet long, and 120 feet wide, and contains approximately 15,000 tons of coal. There are tunnels running underneath, through which railway trucks can pass so as to draw off their loads of coal. The next illustration shows the premises which have been erected for the Bournemouth Gas and Water Company. We have here a reinforced concrete power-house, engine-house, coal-stores, water-tanks, and so forth. The next view is of an isolated tar-tank, which was also built for the Bournemouth Company. After the structure was completed, it was found that the foundation for the centre column was not satisfactory. A new one was put under the tank, and since then it has proved satisfactory. [The lecturer gave other illustrations of the use of reinforced concrete; one being of the Swanscombe coal-pocket during its construction. It showed the centring for the walls erected in such a manner—all of it being bolted together—that it could be easily taken down and erected in another place. Another view was of a large gasholder tank, the foundations of which were put in in reinforced concrete. Mr. Kahn said the addition of a comparatively small amount of steel in these foundations allowed of their being made one-third as thick as though ordinary concrete had been used.]

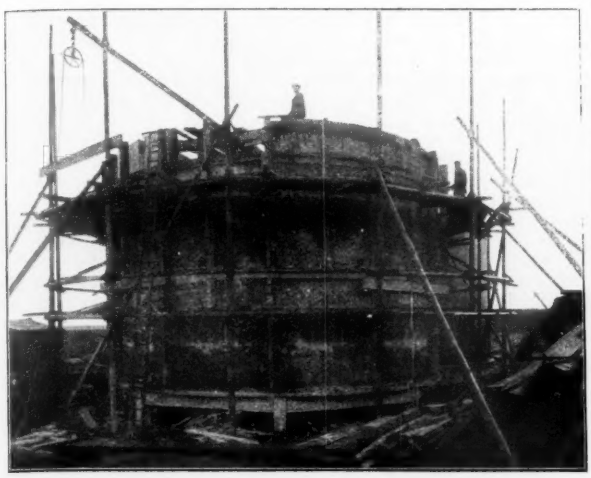


Range of Buildings built of Reinforced Concrete at the Bournemouth Gas Company's Works.

In conclusion, the lecturer said: I should like to draw your attention to the position taken by various bodies on this subject. Large corporations do not hesitate to invest very large sums in structures built of reinforced concrete; yet the Local Government Board assume that the material is still in such a primitive state that they cannot allow a long term for the repayment of loans thereon. In fact, while they grant thirty years for loans used for stone and brick structures, they will only allow fifteen for the repayment of money to be used in a reinforced concrete structure, which is a permanent thing. This seems exceedingly peculiar; for if such a structure is not to be a success, its failure will become apparent within thirty days after its completion. If it successfully passes through these thirty days, one can depend upon it being permanent. The Local Government Board actually carry this matter to an extreme. If ordinary concrete is used, they will allow as much as thirty years for the repayment of a loan; but the moment one places any amount of steel in the concrete, they reduce the time to fifteen years. I know of a particular case where a water supply system was to be laid with concrete pipes, not reinforced. The term allowed for the repayment of the loan was thirty years. A certain manufacturer in England secured this contract, and for his own satisfaction he wanted to use some reinforcement in the pipes, keeping the size of the concrete the same as that shown in the unreinforced pipes. In other words, he was actually willing to give something more than was required of him. The moment he suggested the use of rods in these pipes, the period for the repayment of the loan was immediately reduced to fifteen years, and his scheme was rejected. I am at a loss to account for such action. The building bye-laws of various cities are also somewhat opposed to this class of construction being generally adopted—that is, the authorities will not allow anyone to take advantage of its extra strength for walls. But these laws are now under review; and I feel certain



Pine Hill Coal-Breaking Plant, Scranton, Pa.
Kahn System of Reinforced Concrete.



The Tar Tank at the Poole Works of the Bournemouth Gas and Water Company.

that the merits of reinforced concrete will be recognized in the revision.

SOME QUESTIONS AFFECTING REINFORCED CONCRETE.

Mr. R. O. PATERSON (Cheltenham) proposed that the thanks of the members be tendered to Mr. Jones for his paper, which was of considerable interest, and to Mr. Kahn for his instructive lecture. He should like to say how interested he had been with the lecturer's description of this very useful building material, and of its uses. For work of a considerable character, however, it had been his (Mr. Paterson's) feeling from the first that he should not care to trust this class of building material. He was free to admit that it was his want of knowledge of the subject that caused him to have such a feeling. Mr. Kahn had, he thought, that day proved his case; and they were indebted to him for having so lucidly brought before the members the merits of this method of building. He did not imagine that in gas-works generally, it was of such large importance, excepting perhaps for gasholder tank construction. In this class of work, he should think that it would prove eminently suitable. Regarding Mr. Jones's paper, he had brought before them some most interesting facts with reference to the work that had to be encountered in connection with the distribution of gas in a mining district. Respecting the author's comparison between lead-wool and solid-lead joints, it was somewhat disparaging to the latter; and he did not think he could possibly agree with Mr. Jones. He (Mr. Paterson) had no complaint to make with regard to lead-wool; but he thought it was going a little too far to say that they could make a sound joint with it when they could not make it with cast lead. He entirely disagreed with Mr. Jones that a joint could not be made as well with cast lead as with lead-wool—he would not, however, say better.

Mr. H. E. COPP (West Bromwich), in seconding the motion, observed that the paper by Mr. Jones was peculiarly interesting to him, because he was also situated in a district that was subjected to some of the difficulties experienced by the author. He agreed with Mr. Paterson's remarks with regard to lead-wool joints. He had made a number of experiments; and he must say that he was old-fashioned enough to prefer cast-lead joints. Regarding Mr. Kahn's paper, he had tried a few experiments with reinforced concrete. Some time ago, he had occasion to cover a small building, which he wished to cover in a solid manner; and he tried concrete reinforced by expanded steel plates. He was astonished, on testing the concrete blocks that he made, what an immense difference it effected in the breaking strain of the block when the steel was placed on the bottom or tension side. A remark made by Mr. Kahn was somewhat in opposition to an opinion that he had formed. He had always considered it was better to leave concrete without disturbing it, in order that it might complete what he might call the process of crystallization. He did not know whether in Mr. Kahn's system, any special kind of cement was employed.

Mr. VINCENT HUGHES (Smethwick) asked Mr. Kahn what tensile strain he guaranteed on these bars. He believed that they could only be obtained through Mr. Kahn; and therefore it seemed to him that they had to have just what he chose to send them. The lecturer might reply that they had the responsibility of the construction of the building afterwards; but still he (Mr. Hughes) knew that in some cases failure of the Kahn system had resulted. He had been deeply interested in both the Kahn and the Hennebique systems, because he believed the system of reinforced concrete construction was most useful for gas engineers. But there was one side of the question that Mr. Kahn had not touched upon. In a publication called "Concrete and Constructional Engineering," he had read an account of a failure of a reservoir at Downside Abbey, near Bath. He believed the contractor who originally took this matter in hand constructed the reservoir, and it failed. Then Messrs. Kahn were approached; and their system was adopted. But, according to the paper from which he obtained his information, their system had also failed. He should like Mr. Kahn to let them know something about this, because in connection with gas-works they, as engineers, had to answer to Corporations and Directors; and repeated failures were not so lightly passed over as perhaps they had been at Downside Abbey. In the same publication, there was a description of the failure of a large building which was erected for the Kodak people at Rochester (U.S.A.). Several lives were lost; and the remarks of the Coroner were interesting. He said: "I also draw the following conclusions of fact from the evidence and the study of this accident. The Kahn bars, and similar bars, with shear members attached, are not suitable for columns, because of the difficulty in properly tamping the concrete. No steel concrete structure can be considered safe unless some reliable man is absolutely responsible for putting the proper number of proper-sized bars in the positions designated for them. The allowable stress upon steel and concrete in construction should be fixed by law, so that the safety of the public would not depend upon the cupidity of energetic contractors or parsimonious designers." He (Mr. Hughes) should like from Mr. Kahn some information on the points as to the strength of the bars and these failures. The lecturer had given them some beautiful illustrations of success; but it was only when they came to the question of failures that they arrived at the whole truth.

Mr. W. J. R. BAKER (Great Malvern) observed that some twelve to fifteen months ago, they were discussing at Malvern the construction of a tank for cooling the liquor from a sulphate of ammonia plant. At the time, they were constructing tanks on the reinforced concrete system in Malvern in connection with the sewage works; and he obtained quotations for a liquor tank. He came to the conclusion that a tank 7 feet deep was more expensive in reinforced concrete than it was when built of brickwork and ordinary concrete. From a conversation he had with a representative of one of the ferro-concrete firms, he came to the conclusion that a tank must be more than 7 feet deep before any economy could be realized. As to a guarantee, the ferro-concrete people would not give a guarantee for this liquor tank, unless it was lined with lead.

Mr. COPP inquired whether the co-efficient of the steel bars was identical with the ratio of expansion of the concrete; and, if so, whether any special concrete was required to bring about this condition.

The motion was unanimously carried.

Mr. JONES expressed his acknowledgment to Mr. Paterson and Mr. Copp for their remarks concerning his paper, and to the members for their appreciation. Mr. Paterson had misunderstood him if he thought he had condemned the molten metal joint, because he himself had had molten lead joints made that had stood up to 750 lbs. pressure. But they were able to get to a higher pressure and to a higher tensile strength (as it were) with the lead-wool joint than with molten lead.

Mr. KAHN, in the course of his reply, remarked with regard to the setting of the concrete that the men carrying out the work should not travel over the new concrete. The concrete should be left about twenty-four hours; and the following day one could travel over it to his heart's content, providing the centring was left in. English cement was probably the finest cement in the world. It was better than American or Belgian cement, and better than the ordinary cement which was known as natural cement. Within ordinary limits, the co-efficient of expansion of concrete and steel was nearly identical. If it were not so, the moment a structure became heated, the steel would expand more than the concrete, or *vice versâ;* and in this way the rod would slip and break its skin-friction. They knew that this did not happen. They knew that up to 2000° Fahr.—and there was no reason for limiting it to 2000°—the co-efficient of expansion of concrete and steel was identical. Regarding the tensile strain of the steel, they tried to have the steel of the very best they could get in England. English steel was not so good as American steel; but the Scotch mills were giving a fine grade of steel. His firm did not, however, assume anything; they took the bars and tested them. As to the failure of the Downside Abbey reservoir, that was about 80 feet square and 13 feet deep. The original contractor put in a floor 3 feet thick, filled the reservoir with water, and went away. The reservoir collapsed; the reason being under-mining for coal. His firm were then consulted; but when they found the ground was subject to fissures in the rock, they refused to carry out the work, and to assume any responsibility for it. However, the plans they were asked to prepare were adopted; and Lloyds thought well enough of the design to insure the reservoir. After it had been built on their system, at one corner another fissure occurred. The wall came down there; but the reservoir was not by any means a complete failure, and Lloyds paid for the damage without question. Their system was not in any way to blame for an act of Nature. The Rochester failure was due to the men not following their instructions, and to the premature removal by them of the centring which caused a portion of the building to fall. He did not think the Kahn bar could be blamed for that—in fact, the owners absolved the system from all blame. The investigation by experts proved the Kahn bar was a success. They might have good material, but put it in the hands of a poor workman, and he would give a poor job. They had had four failures in all—the two mentioned, and one in which the system was only partially used, and in the other the engineer used the bars upside

down. Against these four failures, they had 1400 successful buildings during last year, involving an expenditure of 4½ millions sterling. Reinforced concrete tanks 7 feet deep were not economical; but get a tank (say) 11 feet deep, and there would be an advantage in the reinforced concrete construction.

Election of Office-Bearers.

The President announced that, as there had been no other nominations for officers for the ensuing year, he declared the following gentlemen duly elected:—

President.—Mr. H. E. Copp, of West Bromwich.

Vice-President.—Mr. W. Langford, of Longton.

Hon. Treasurer.—Alderman Cooper, J.P., of Banbury.

Hon. Secretary.—Mr. Charles Meiklejohn, of Rugby.

New Members of Committee.—Mr. H. Lee, of Hinckley, and Mr. A. T. Harris, of Market Harborough.

Auditors.—Mr. B. Ely, of Pye Bridge, and Mr. A. Bird, of Bromsgrove.

Visit to the Manchester Exhibition.

There was some discussion to ascertain whether it was possible to organize a visit, to the Manchester Exhibition, of members, their Chairman, Boards, and Committees. Information was given by Mr. Meiklejohn and Mr. S. Meunier; and in the end it was agreed that Friday, Nov. 1, would be a convenient day for the visit—members and friends making their own travelling arrangements. The Manchester Institution were heartily thanked for their invitation, and also Mr. Meunier for attending and affording information.

The Case of Mrs. Parsons.

The President said the sad case of Mrs. Parsons would be in the minds of the members. She was left a widow with two young children. To an appeal, the members had responded to the tune of £34. This was a very nice start; but he hoped no member would feel that he was compelled to give a guinea or half a guinea. He should like to see the small sums coming in; so that they could do some real good for this poor woman. He would be glad if the members would make known this case among their friends.

Mr. A. Cooke (Oldbury) said there might be mention made of the fact that, from the Benevolent Fund of the Institution, a grant of 15s. a week had been made; and the thanks of the members were due to Mr. Berridge, Mr. Meiklejohn, and Mr. Bell for the good work they did in securing this. He thought that this would bring home to the members the necessity of subscribing to the Benevolent Fund.

The President observed that it had been brought to his notice two or three times that the Midlands benefited from the Benevolent Fund to an amount exceeding the subscriptions of all the members of the Association to the fund. Of course, in this instance, their own Association were making a special effort on behalf of Mrs. Parsons.

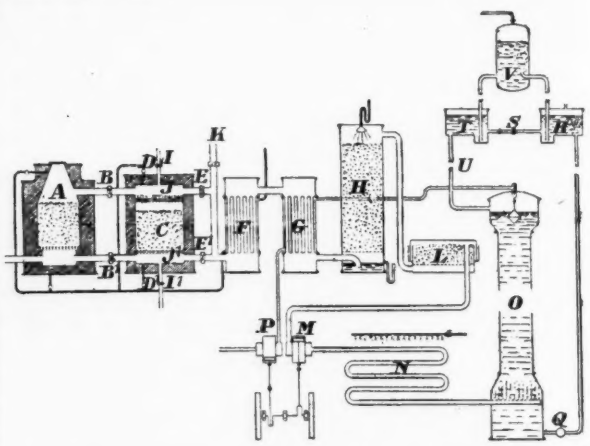
This concluded the business proceedings; and afterwards high tea was served.

REMOVING CARBONIC OXIDE FROM GASES.

The Lyons Gas Company have taken out a patent in France for a process to remove, or at all events reduce, the carbonic oxide contained in combustible gases, especially water gas. The nature of the process will be gathered from the following abstract translation of the specification, the full text of which was published in a recent number of "Le Gaz."

Water gas, coal gas, and most industrial combustible gases, contain hydrogen, carbon monoxide, hydrocarbons, and various inert gases, such as nitrogen, carbonic acid, &c.; and it is their high percentage of carbon monoxide that has most frequently limited their employment. It is therefore highly desirable to reduce the proportion of the last-named constituent, and, as far as possible, allow the hydrocarbons to remain. This can be done by substituting hydrogen, or compounds of hydrogen and carbon, for the carbon monoxide. The well-known reaction of hydrogen and carbon with steam ($CO + H_2O = CO_2 + H_2$) furnishes a partial solution of the problem; but hitherto it has not been possible to practically apply it. Recent researches, however, have rendered the reaction suitable to a certain extent—on the one hand, by taking advantage of the catalytic properties of metals and metallic oxides in a suitable condition, which obviates the necessity for working at a high temperature, and avoids the decomposition of the existing hydrocarbons; and, on the other, by improving the conditions for the removal of the carbonic acid produced by the reaction, as well as that already in existence.

Taking, for instance, water gas of average composition—*i.e.*, containing 50 parts of hydrogen, 40 of carbonic oxide, 4·5 of carbonic acid, 0·5 of methane, and 5 of nitrogen—it is sufficient to pass the gas at a higher temperature than 400° C., in the presence of steam, over fragments of oxide of iron, to obtain very considerable reduction of the carbonic oxide. Indeed, this constituent may be taken out entirely if the operation is conducted in succeeding stages, either before or after the removal of the carbonic acid formed. In the example given, there is obtained, after a single passage of the gas at a temperature of 600° C., a gas of the following percentage composition: Carbonic acid, 27·1; carbonic oxide, 6·9; hydrogen, 61·8; methane, 0·4; and nitrogen, 3·8. After the removal of the carbonic acid, a gas of the following composition is produced: Carbonic oxide, 9·4; hydrogen, 84·8; methane, 0·6; nitrogen, 5·2. The calorific power is slightly higher than that of the original gas, while its specific gravity is much less (·20 instead of ·54). The oxide of iron employed is not impaired by the impurities, such as sulphur, &c., in the gas, nor by the ashes and dust carried forward from the producer. Consequently, no useful purpose is served by passing the gas through scrubbers before the reaction—thus losing the advantage arising from the direct utilization of the gases at the high temperature at which they leave the producer. Moreover, the superheated steam, especially in the case of water gas, is immediately utilized at the producer outlet. After leaving the catalyzer, the gases can be conveyed to the condensers and washers, and then freed from carbonic acid, after passing through oxide of iron to remove the sulphurous products, or undergoing any other method of purification required by the constitution of the gases under treatment.



The apparatus employed in carrying out the process patented by the Company is shown in the accompanying illustration. It consists of a producer A, from which the gas is conveyed by the bye-passes B B^1 into the catalyzer C; the pipes D D^1 allowing of the introduction of the requisite steam. After going through the catalyzer, the gases are conveyed, by means of the bye-passes E E^1, through a double superheater F G, near the washer H. The illustration represents a producer of the Dellwik-Fleischer type, in which the generating operations can be carried on alternately downwards and upwards. The inlets for the secondary air, I I^1, allow of the heating of the catalyzer to the requisite temperature at starting by burning the producer gas at J J^1. During this period, the products of combustion are carried off through the bye-pass K. On leaving the washer, the gases pass into one or more purifiers L, to be compressed by the pump M. They are afterwards conveyed through a refrigerator N to the base of the saturation column O. Once freed from carbonic acid, they are expanded in the engine P of the pump M; but after they have been heated in the heat-transformer G, they are then ready for use. The liquid charged with carbonic acid in the column O rises in the column Q R, the height of which is such that the liquid finds its level at R under atmospheric pressure. Having given up part of the carbonic acid with which it was charged, the liquid is conveyed by the pipe S, the reservoir T, and the pipe U to the column O. It is to be noted that in the column Q R the liquid is subjected while ascending to diminishing pressures, and consequently dissolved gases are liberated in bubbles in the mass. The ascent of these bubbles will facilitate the circulation of the liquid. But in order to regulate this circulation at will, and set the apparatus working, there is located at Q a pump, a compressed-air injector, or simply a source of heat. However, the liberation of the dissolved gas being rendered incomplete, owing to the well-known phenomena of saturation, it is advantageous to lower the pressure of the liquid below that of the atmosphere. To do this, instead of conveying the liquid direct from R to T through the pipe S, it is sent through a syphon V of such a height that there will be in the upper portion a vacuum similar to that of steam-engine condensers. The carbonic acid flows at R at very nearly atmospheric pressure; whereas in V it must be drawn up by a pump or an injector.

In the illustration, the column O is shown in outline; but, of course, it is furnished with reversed plates or any other suitable means to retard the ascent of the gases, and prolong their contact with the liquid. In the reservoir R also there are baffles, agitators, or dividers, to facilitate the liberation of the dissolved gases. The process may be combined with others utilizing exclusively variations in the temperature of the liquids employed to wash the gases. R and V would then be the hot chambers, while the low-pressure chambers and the column O would be the cool and high-pressure portion of the apparatus.

YORKSHIRE JUNIOR GAS ASSOCIATION.

The Annual Meeting of the Association was held on Saturday, in the University Buildings, Leeds, where each of the previous annual meetings has been held. A very large attendance of members was secured, pointing to a widespread interest in the newly-equipped Department of Fuel and Metallurgy, and a sense of the honour conferred on the Association in its being the first organization to inspect the new buildings.

Mr. G. W. FLIGG (the outgoing President) took the chair at the business meeting, which was held in the Chemistry Lecture Theatre; and, in opening the proceedings, he congratulated the members on the sustained interest shown by members and onlookers alike in the work of the Association, and on the unbroken harmony and friendliness of their gatherings. He had had a good time during his year of office, and had been admirably supported by his colleagues on the Council and by all the members. He rendered heartfelt thanks to all, and should retain a lively sense of pleasure and pride in his term of presidency. He need not assure the members that he should ever retain a strong interest in, and affection for, the Association; and he hoped to have many opportunities of serving it in the years to come.

The SECRETARY (Mr. C. T. B. Roper) presented his report on the year's working, and announced that the numbers were now 96 ordinary and 9 honorary members. He called their attention to the invitation that had been extended to them to visit the Gas Exhibition at Manchester on the 2nd of November, in company with members from the Manchester, Midland, and London Associations. A full programme had been arranged, details of which they would receive in due course. The utmost cordiality had been shown by the Committee of Management and the Manchester Junior Association, and he trusted that they would attend in very large numbers at what would really be the first united gathering of all the English Junior Associations. He had received letters of regret at their enforced absence from Mr. J. H. Brearley, of Longwood, and Mr. E. J. Wellens, the President of the Manchester and District Junior Association. In reply to questions, he added that the library they had formed had been made use of to a gratifying extent, and no trouble had been occasioned by members retaining books for an undue length of time.

The TREASURER (Mr. H. D. Lumb) then presented his financial statement, and answered several questions on its details.

Both reports were accepted by the meeting, after testimony had been borne to the watchful economy shown in the work and to the self-sacrificing zeal of the Secretary in carrying out his duties.

The ballot for officers resulted in the following elections:—

President.—Mr. J. H. Hill, of York.

Senior Vice-President.—Mr. H. Butterfield, of Silsden.

Junior Vice-President.—Mr. S. W. Shepherd, of Bradford.

Ex-President.—Mr. G. W. Fligg, of Dewsbury.

Secretary.—Mr. C. T. B. Roper, of Bradford.

Treasurer.—Mr. H. D. Lumb, of Mirfield.

Council.—Messrs. W. N. Booth, of Huddersfield; W. Cranfield, of Halifax; E. Gillett, of Bradford; F. Scholefield, of Dewsbury; E. J. Sutcliffe, of Bradford; and L. V. Whitaker, of Pontefract.

Auditors.—Messrs. E. E. Stones, of Elland, and C. H. Turner, of Mirfield.

Mr. FLIGG formally installed his successor, Mr. J. H. Hill, of York, and extended to him his congratulations and good wishes for a happy and successful year of office.

In responding to the hearty welcome accorded to him, Mr. HILL thanked Mr. Fligg and the members generally. He said he was proud of the Association and its record of work; and as he contemplated its great possibilities of usefulness to the young men, he found himself wishing that he had had similar privileges and facilities in his earlier days. It was one embodiment of a fine movement, which would have far-reaching issues. The Junior Associations had a sphere specially their own, even though many of their members might look forward hopefully and expectantly to becoming members of the Senior Associations. They still had their reputations and their careers to make; they were free to develop their individual selves along their own lines, untrammelled and not obliged to conform to patterns, and without the fear of authority cramping their opinions. The freedom of thought and individual preference which they prized nationally could be theirs here also. His aim as President would be to heartily encourage members to advance along these lines. He hoped to foster the incipient attempts of the younger men, and to sympathize with every effort they might make to utilize the meetings of the Association to their educational advantage.

A comprehensive vote of thanks to the Officers and Council was passed and acknowledged; and the thanks of the Association were voted to the University authorities for their kindness in granting the use of the room for the meeting, and consenting to the subsequent visit to Professor Bone's department.

Following the business meeting there has hitherto been a lecture, which has always been a distinguishing feature of the Association's yearly programme. When the Professor of the newly-instituted Department of Fuel and Metallurgy (Dr. W. A. Bone, F.R.S.) was approached earlier in the year, he consented to address the members on the present occasion, but begged to be excused from promising a lecture, inasmuch as the possibility of its experimental illustration might be jeopardized by the non-arrival or erection of the complete equipment of a department the foundations of the buildings for which were only just then being laid. In place of a lecture, he suggested a visit of inspection to his new department and to that of his mining colleague, Professor George R. Thompson—promising to supplement this with a short address. That Professor Bone was wise in suggesting this alteration was proved by the fact that, owing to the late arrival of part of the equipment, there was for some time a possibility of the meeting having to be postponed; and although, by strenuous work, the building was made fit for the Association's visit and inspection on Saturday, its equipment was not wholly in position and working order, while Professor Thompson's rooms were still further in arrears—important pieces of his specially designed equipment being yet on its journey. Under these conditions, and by Professor Bone's express desire, the detailed description it was hoped would have formed part of the report of the Association's annual meeting is postponed for a few weeks.

Leaving the main block of the University Buildings, the members made their way to the new building which now houses the Department of Mining and that of Fuel and Metallurgy. They there assembled in the lecture-room before beginning the examination of the contents of the building.

The PRESIDENT, on taking the chair, said that no more pleasurable duty would fall to his lot during his presidency than that of introducing to them as "guide, philosopher, and friend," Dr. W. A. Bone, who had for years been engaged in pioneer research work on the combustion of hydrocarbons—investigating the steps in the process of combustion and explosion, and revealing that these were not simple chemical reactions, but a succession of chemical changes, and that what was generally written in equations only represented the final result of these sequences of reactions. This unique study and masterly series of experiments had created widespread interest, and had opened up vistas of great scientific possibilities. They all rejoiced that recognition had been made of Professor Bone's work by the bestowal of the greatest distinction that could be conferred on an English scientist—viz., the Fellowship of the Royal Society. They rejoiced still more that fresh scope and enlarged opportunities had been found for him in the new department of the Leeds University. They might yet be able specially to rejoice in this, in that every member hoped to benefit by the results of the investigations that would be carried out there. The behaviour of some of the hydrocarbons was the bane of their existence; and to learn how to harness these refractory molecules, and induce them to come into line with some other of the hydrocarbons which docilely and beneficently yielded to their control, would be a great boon to the gas industry in the years to come. It was a satisfaction to know that the Institution of Gas Engineers had given their aid to the department, and particularly towards the investigation of gas consumption in relation to hygiene. The modern English Universities had somewhat specialized themselves in their technological work. The study of brewing was at Birmingham, of iron and steel largely at Sheffield, of the leather industries at Leeds, and so on. This Gas Department at Leeds, therefore, was not a mere local one, or even a Yorkshire one, but was really the national possession of a University department devoted to one of our great industries. They hoped its fame would soon become world-wide. All knew to whose initiative and active interest they owed the achievement embodied in that building. Professor Smithells had devoted much time and energy to the inception and fruition of the project. Their congratulations were due to him on having secured the sympathy and active assistance of so many distinguished and influential leaders of the gas industry; and he (Professor Smithells) would watch with a paternal pride and interest the future development of the work. This latest achievement only added to the profession's indebtedness to Professor Smithells for his classic and unshaken series of researches on flame, which work might here be extended in other directions; and as he was always ready to acknowledge his indebtedness to his great master Bunsen, and rejoice in having worked under him, and side by side, as a fellow-student, with Welsbach, so they in their turn would express their sense of gratitude for all he had done for them, and their pride in him and his connection with their Association. Electricity had a novelty that had captured the interest of many scientists; and the weird possibilities that seemed to lie before it had fascinated them all and appealed to their imaginations. But the advent of the incandescent mantle had inaugurated a new era; and again the earnest attention of men of the foremost rank in science was given to the more staid and sober illuminant, that had yet limitless secrets to be discovered.

ADDRESS BY PROFESSOR BONE.

Professor BONE then rose, amid most cordial greetings, and addressed the members as follows.

I count it a great privilege and pleasure to have this opportunity, at the outset of my work in connection with this new Department of the Leeds University, of meeting so many of the younger representatives of that great industry whose interests we hope specially to cultivate and serve. It is, to my mind, a singularly appropriate and happy circumstance that the first meeting of a

body of gas engineers within the walls of this building should be that of a Junior Association, because, however much we may receive and value the practical sympathy and support of the older members of your profession, it is to the younger men that we must look for that continual succession of earnest and enthusiastic students and investigators which is essential to any enduring success.

But while assuring you, both on my own behalf and on behalf of my colleagues, of a very cordial welcome, and of the desire of the University to promote in every way the applications of science to the coal-gas industry, I do not propose to occupy your time this afternoon longer than is necessary to briefly indicate our aims in establishing this new Department and the policy which we hope to pursue. I hope that, in addressing this audience of young engineers, whose life-work lies before them in an age of continual rapid progress in science and invention, it is unnecessary for me to devote much time to insisting upon the value of a scientific training as a preparation for an industrial career. For, however much unreasoning prejudice may still lurk in the minds of older people against what is, after all, only the necessity of the age we live in, I take it that all in this room are convinced of both the moral and material advantages of scientific study and investigation in its relation to the problems which every day confront you. But there still exists so much misconception as to the function and aims of the work of a Department of Applied Science in a University situated, as is this one, in the midst of a vast industrial population, that I may perhaps be allowed to indicate what I consider these functions and aims should be.

In the first place, I think it will be conceded that the social and industrial necessities of the times demand that every man shall have such educational facilities within reach as will enable him to develop his mental powers to the fullest possible extent. If this be admitted, it follows that, after the completion of a certain period of general studies, which form the common basis of all educational work, a man's further training must, in the vast majority of cases, have direct reference to the career or profession he has marked out for himself. In a modern University, whose function it is to provide all things necessary for this higher and more specialized study and research, the student receives such mental training and instruction as will best fit him to be an efficient and intelligent member of the social and industrial community in which his future lot will be cast.

The function of a University, in relation to the world at large, is, in my opinion, primarily to promote and extend knowledge and research, and in so doing to train men and citizens; and secondarily, incidentally to make these men more efficient than they otherwise would be in their individual professional capacities. A modern University may be likened to the old Biblical picture of "Wisdom sitting in the market-place;" and though the time has perhaps not yet come, I hope it is not far distant when the University will form the normal and natural avenue to all the higher ranks of professional and industrial service.

There seems to exist in some quarters the curious misconception that because a University may establish Departments of Applied Science—such (say) as Engineering or Metallurgy—that it professes or pretends to turn out its graduates as finished or accomplished engineers or metallurgists. Let me at once assure you that, so far as I know, nobody in University circles, certainly not in this University, labours under such an absurd delusion. A University Laboratory may be the best place of preparation for a practical career, but it can never be, in any sense of the word, a substitute for actual works experience; and, however excellent and complete may be the arrangement of a Department of Applied Science for advancing and imparting the knowledge of the principles underlying industrial practice, its work, in relation to the students who pass through it, can never be regarded as more than a necessary or desirable preparation for the works or factory.

Having thus cleared away one popular misconception, may I be allowed to deal with another hardly less common, and certainly more dangerous, which probably arose from the long divorce between theory and practice in this country. How often do we hear the remark that such-and-such a thing may be all right in theory, but is bad in practice. If this means nothing more than that in the conduct of practical affairs, and the solution of practical problems, we must have regard to what is economically sound as well as to what is scientifically possible, then it amounts to no more than the axiom that, in the application of scientific principles to any particular set of conditions, the whole of the factors in the situation shall be taken into consideration; and as such it will commend itself to every sane person. But if it implies, as sometimes I fear it does imply, that theory is not to be accepted as a guide in practice, and that rule-of-thumb is to usurp the place of ascertained knowledge, then it becomes a most dangerous and pernicious doctrine which cannot be tolerated.

In this connection, I recall the words of a distinguished physicist—one of the leading scientific men of the day—at the opening of his new laboratories in a great city not far from this place. Speaking to an audience largely composed of business and practical men, he said he would like to inscribe over the portals of his laboratories the words, "What is sound in theory cannot be bad in practice," for this belief really constitutes the *raison d'être* of the existence of our new department. Those who believe in this dictum will come to avail themselves of the facilities here offered, not only of gaining that "theoretic" knowledge, but also—what is more important still—the power of discerning between what is sound and unsound in theory, and of applying the sound in after years to industrial practice.

This is really the *crux* of the whole matter. The functions of this new department are: (1) By its teaching to impart sound knowledge; (2) by its scientific research to continually sift that knowledge, so as to distinguish between what is sound and unsound in theory; (3) by its close association with the industry at its doors to help those responsible for the conduct of practical affairs, so to apply the sound in theory that it may be most fruitful in practice; and, lastly, so to combine its teaching, research, and industrial connections that its students shall be trained in an environment of ceaseless mental activity and strenuous practical effort.

But we need not, and should not, overlook the moral value of scientific training. "Man does not live by bread alone;" and the material advancement of an industry must not be the sole aim and end of a department such as this. I hope we may turn out men who will not only become better gas managers, but also better men, for their training here. A scientific laboratory is at once the most democratic and most aristocratic of places. A man, whatever his advantages of wealth and station, here quickly finds his level; and while there are equal opportunities for all, there is finally that aristocracy of talent and merit in which only men of character and ability can find a recognized place.

Turning now to the aspects of our work which have a more direct bearing on the gas industry, we at once face certain prominent and insistent problems. I will dismiss till another time the mention of the problems surrounding carbonization, and refer first to lighting. I suppose that with the advent of the incandescent mantle, and its pretty general use, we now have in gas the cheapest form of artificial lighting, and what for many purposes is the most convenient. Possibly we may have reached a period when only minor developments may occur in connection with lighting, and when we may see no second discovery or invention comparable with the revolution produced as the outcome of Welsbach's labours. Yet the use of the incandescent mantle challenges our scientific research, and raises questions of great scientific importance; so that the patient investigation of the problems associated with its development of light will probably reveal secrets fraught with benefit to us who are primarily concerned with scientific theory, and to those who are directly interested in the general use of this form of lighting.

The question of gas heating, its problems, and the far-reaching issues that open up around it, are of even more immediate importance. Any observant person who can get beyond the stage of too ready acceptance of the inevitability of our present everyday conditions cannot but be impressed and depressed by the hideous sordidness and ugliness which in our towns are largely due to the smoke nuisance. This ever-present nuisance deprives us of much beauty of form, colour, and light that we might enjoy both in Nature and in our buildings, spoils much of the beauty we attempt to create, and spells disease and death to countless thousands. The solution of the difficulty is largely a question of the use of gas for heating—not our present coal gas only, but other gases which will play their part in the great reformation. So that a department like ours can apply itself to few more fruitful and pressing problems than to increasing the efficiency of gas for heating, and facilitating its more extensive use. If thus, in course of time, any work inaugurated here does make gaseous fuel more efficient, more economical, and thus more commonly used than raw fuel, we and all associated with us in the inception, institution, and maintenance of this department will have participated in conferring an incalculable benefit on mankind. I know of few dangers to the health of men so universal, persistent, and serious as this widespread nuisance, and few more appealing calls to Science than to assist in the amelioration of its effects. We hope that we who are now engaged here, and those who in the years to come will work within these walls, may, in large or small measure, help to the consummation of this ideal.

Inspection of the New Building.

Professor Bone had intended giving some detailed account of the courses of lectures and work contemplated in his department, but, as the hour was getting late, he contented himself with distributing copies of the prospectus. In parties, under the leadership of himself, his Assistant (Dr. Henstock), and Professor Thompson, the members made the tour of the building. Though detailed description is reserved, mention must be made of the fulness of equipment and of the evident embodiment of long experience and much concentration of expert thought and planning in the design not only of the plant and apparatus, but of the permanent features and gas, water, electrical, and blast fittings of the building. The Mining Department was as fully gone through as the Gas Department; and already it is evident how much advantage will accrue to students and to the professions concerned from the close alliance and interworking of the two.

In the concluding informal gathering, votes of thanks were enthusiastically accorded to Professors Bone and Thompson.

Mr. Seager Berry has resigned the position of Solicitor to the London County Council, which he has held since 1905, and at to-day's meeting of the Council the General Purposes Committee will recommend that the vacancy be filled by the appointment of Mr. E. Tanner, at present Deputy-Solicitor.

LONDON AND SOUTHERN JUNIOR ASSOCIATION.

Visit to the Wandsworth Gas-Works.

The recent excellently attended opening business meeting of this session of the London and Southern District Junior Gas Association, was followed on Saturday by an outing which was equally successful in point of attendance and in every other respect. The visit was to the works of the Wandsworth and Putney Gaslight and Coke Company, where the seventy or more members who were present found plenty to occupy their attention, under the guidance of the Engineer (Mr. H. O. Carr), who fully and clearly explained everything by the aid of a megaphone. Useful assistance in the way of answering questions and drawing attention to points of interest was also rendered by Mr. O. W. Dougan and Mr. Hancock. It may be mentioned that the maximum daily make of gas at the works is 4 million cubic feet; while the annual output is 1000 millions.

The inspection naturally began at the retort-houses. There are three of these; but one has for a long time been entirely out of use, and another is only put into work at the very busiest time of the year. At present, gas making is confined to one large house, the retorts in which are on the horizontal system, and fired by Gibbons's regenerators. The retorts are charged and discharged by means of steam-operated machinery, which was designed by Mr. Harry S. Freeman, formerly Engineer, and now a Director of the Company; and this is found to be very effective. Six-hour charges are worked, and eight-hour shifts. The works are situated on the banks of the Thames, and the greater part of the coal required is brought up by steamer, and unloaded into barges and on to a pontoon floated out into the river; and from these it is removed by grabs. The pontoon itself is capable of holding some 300 tons. When the coal reaches the works, it is transferred to the elevators, and carried by two systems of conveyors to the coal-stores running alongside the retort-house; and from there it descends by gravity on to the stages. There are four scrubbers—two square and two round—filled with coke on open wood grids. The two exhausters which were running at the time of the visit are of the Bryan Donkin Company's latest type; and each is of a capacity of 100,000 cubic feet per hour. Close by these are two station-meters, made by the Gas-Meter Company, also passing 100,000 cubic feet per hour each. For purification purposes oxide of iron only is, of course, now used. This is placed in seven purifiers, 40 feet by 36 feet, in five tiers. The oxide is loaded by means of friction clutch elevators, driven by a gas-engine. Skips are elevated from a carriage running on the ground below the purifiers, and deposited upon another carriage which travels on rails along the side of the purifiers on to turntables, and thence across the vessels. The purifiers are emptied by means of manhole covers at the bottom; and the lids, which are gaskin jointed, are raised by the aid of travelling apparatus, and carried away over another box, thereby leaving the whole surface of the uncovered purifier clear for operations. In addition to these, there are four purifiers 30 feet square, which are used only for carburetted water gas.

A point on which considerable interest was evinced was the water supply of the works. This is obtained from an artesian well 630 feet deep, and capable of discharging 5000 gallons per hour. The water, which is raised by means of compressed air, is of excellent quality, free from all impurities, cool, and specially adapted for boilers, as it deposits very little scale. The sulphate of ammonia stills turn out about 3 tons of salt a day; and in a house adjacent to them there are two sets of Humphreys and Glasgow's carburetted water-gas plant, of a total capacity of 1,800,000 cubic feet per day. There are on the works six holders. The largest of these is of 1,750,000 cubic feet capacity, and is constructed on the braced girder system, to the design of Mr. H. E. Jones, the Chairman of the Company. It has a concrete tank. An inspection was also made of the machine-shops (where there were seen a number of excellent machine-tools), the sawmills, the stores, the meter and stove repairing departments, and the laboratory, where the visitors were shown a specially long (20 feet) photometer, for the testing of high-power lights.

A couple of hours and more having thus been pleasantly and instructively spent, the party were conducted through the offices to the board-room, where they were entertained to tea; and before separating, a hearty vote of thanks was, on the proposition of the President (Mr. W. Upton), passed to Mr. Carr for the kind manner in which he had received the members and for the trouble taken to explain everything to them, and to the Company for the privilege accorded them of so thoroughly inspecting the works.

In a type of gas-engine developed by the Allis-Chalmers Company, Milwaukee (Wis.), for the power-houses of the Indiana Steel Company, at Gary (Ind.), 44-inch gas-engine cylinders for 54-inch strokes are being made. These are claimed to be the largest cylinder diameters of any engines put up in the United States. The engines are four-cycle twin tandem direct-acting types, designed to give 4000 H.P. on blast-furnace gas of 80 to 85 B.Th.U. and up to 5000 H.P. on richer gases. They are intended for direct connection to alternating-current generators. The crank-pins are 20 inches, the shaft is 30 inches, and the fly-wheel 23 feet diameter. The entire engine weighs roughly 670 tons.

INDICATED POWER AND MECHANICAL EFFICIENCY OF THE GAS-ENGINE.

At the Meeting of the Institution of Mechanical Engineers on Friday, a paper on the above subject was read by Mr. BERTRAM HOPKINSON, M.A., Professor of Mechanism and Applied Mechanics in the University of Cambridge.

The author began by reminding the members that in the report of the Committee of the Institution of Civil Engineers on the Efficiency of Internal Combustion Engines, which was noticed in the "JOURNAL" for Sept. 4 last year, the following remark occurred: "It would be desirable, but for one circumstance, to calculate the relative efficiency only from the indicator horse power. But it appears that in the case of gas-engines, and especially gas-engines governed by hit-or-miss governors, the indicator diagrams do not give as accurate results as is generally supposed. The diagrams vary much more than those of a steam-engine with a steady load; and the mean indicator horse power, from the diagrams taken in a trial, may, it appears, differ a good deal from the real mean power." This statement, said the author, was fully borne out by the tests made by the Committee, which showed that the mechanical efficiency taken as the ratio of brake to indicated horse power varied from 80 to 94 per cent. in the three engines tested. These were of similar type, but of different sizes; and whereas the smallest, of 5 H.P., showed a mechanical efficiency of 90 per cent., the intermediate engine, of 20 H.P., had the lower efficiency of 80 per cent. The author said the opinion of the Committee was obviously important, and might be expected to have a widespread effect in gas-engine testing; for it threw doubt upon many of the efficiency tests which had hitherto been made and published. Moreover, the method the Committee adopted for getting the indicated power from the brake power seemed to require further investigation before it could be accepted as accurate. He therefore determined to undertake an investigation with the object of finding out whether the indicator power of a gas-engine does, in fact, vary so much and is so difficult of determination as the Committee suggested. If it were found that the indicated power could be accurately determined directly, it was further desired to test, by direct comparison of brake and indicated power, the validity of the Committee's method of getting the mechanical efficiency. The engine used in the tests was placed at the author's disposal by Messrs. Crossley Bros., and was intended to give a maximum output of 40 H.P. on the brake. The following are the particulars of it: Cylinder, 11¼ in. diameter and 21 in. stroke; speed, 180 revolutions per minute; compression space, 407 cubic inches; compression ratio, 6·37; compression pressure, 175 lbs. per square inch absolute. When exploding every time, the indicated horse power at 180 revolutions per minute was not quite half (0·495) the mean effective pressure. The engine worked the ordinary "Otto" cycle, governed by hit-and-miss. It was loaded by belting it to a dynamo, which also served to motor it round when required. The fuel used was Cambridge coal gas; and the engine was fitted with an exhaust gas-calorimeter of the spray type.

For measuring the supply of gas, a standard holder, by Messrs. Parkinson and Cowan, having a capacity of 10 cubic feet, was placed between the main supply and the engine, and as close as possible to the latter. In the ordinary running of the engine, the holder stood at a constant level—the flow of gas into it just balancing the flow out; and under these conditions it served as a gas-bag, coming down by about 1-10th of a cubic foot at each suction of the engine. In a measurement of gas consumption, the supply to the holder was cut off, so that the engine drew gas only from the holder, and the quantity taken in a definite number of suctions (usually about 50) was noted. After the completion of the measurement, the inlet-pipe to the holder was opened, and the counterweights adjusted so that the holder slowly rose to nearly its highest position, when the measurement could, if necessary, be repeated. It was possible in this way to read off the consumption correctly to 1 part in 500; and, allowing for possible inaccuracies in the gasholder divisions, small changes in temperature and pressure, &c., the author said it might be taken as certain that the gas consumption given was within 0·5 per cent. of the truth. He added that this method of gas measurement was specially adapted for cases like the present, in which the actual gas used in a particular cycle or series of cycles was desired; but it was almost equally suitable for the measurement of gas consumption for a long period. It was found that it made no perceptible difference to the power given by the engine whether the inlet-pipe to the holder was open or closed; and therefore it might be assumed that the gas consumption remained the same under the two conditions. The rate of consumption determined by the holder might, therefore, be assumed to continue during the intervals when the holder was filling or was standing at a constant level. This method of measurement, which was much superior in accuracy to any meter, and was very convenient, might easily be applied to much larger engines, since all that was required was a holder of sufficient capacity to run the engine for about one minute.

The first requirement for the investigation proposed was an accurate indicator; and, in order to get at all satisfactory results it was necessary to construct an instrument which could be relied upon to give the indicated power within 2 per cent. Moreover,

one was needed which would really be capable of working for long periods without breaking down, so that large numbers of diagrams could be taken under given conditions. The author's experience of indicating gas-engines had convinced him that it was quite impossible to fulfil the first of these conditions, to say nothing of the second, with any form of pencil indicator. After considering the capabilities of the various instruments, he determined to get one of new design, of the "piston and spring" type, with optical magnifying mechanism. In the form finally adopted, after a considerable amount of experimenting, the spring consists of a straight piece of steel strip held as an encastred beam in a steel frame. A piston slides in a bore communicating with the engine, the axis of the bore being at right angles to the spring and passing through its centre. The pressure on the piston deflects the spring, and so tilts a small mirror about an axis at right angles to the bore, the pivots of the mirror being carried on a steel frame. To give the other motion to the mirror, the whole apparatus (straight spring and mirror with its pivots) is positively connected to an eccentric on the crank axle by which it is rocked about the axis of the bore—thus giving the piston motion of the diagram without the possibility of any lost motion. The instrument is practically indestructible, and it has been left open to the engine for considerable periods without giving it any attention. The vertical deflection is accurately proportional to the pressure, so that the diagrams can be integrated with a planimeter. Finally, the period of oscillation is only about 1-700th of a second with such strengths of spring as were used in the mechanical efficiency tests. The indicator is very easily calibrated by dead-weights. The diagrams used in these measurements were photographed; but for many purposes it has been found sufficient to observe them direct by means of a telescopic arrangement by which they are projected as a bright line of light on to a transparent screen with vertical and horizontal scales. It is quite easy to plot the diagram on to a piece of squared paper, and its area can thus be obtained within 5 per cent. without the trouble of photography.*

Some tests carried out with the instrument above described led the author to the conclusion that, given a sufficiently accurate indicator and constant conditions, the indicated horse power of a gas-engine may be determined from diagrams with an accuracy which is probably superior to that attainable in the steam-engine. He pointed out that the indicated horse power of an engine is dependent upon the gas supply; and the gas taken per suction with a hit-and-miss governor is determined by the temperature of the cylinder walls and piston, and by the opening of the gas-cock. So long, however, as these variables and the pressure in the mains are kept constant, he thought there was no reason why the gas consumption should vary.

Changes of cylinder temperature considerably modify the consumption of gas per cycle with the same opening of the gas-cock. But these changes are, of course, comparatively slow, and do not affect the accuracy of an estimate of indicated power where the conditions are fairly constant. As an indication of their amount, the author cited the following test: The engine was first of all run light with a large flow of jacket water; it was then fully loaded, and the water throttled until the temperature at the exit rose to 185° Fahr. The load was then suddenly thrown off, and the engine was allowed to run light for a short time with the hot jacket. A large quantity of water was afterwards passed through the jacket, so that the temperature of the cylinder rapidly fell to 61° Fahr. The gas taken per suction was measured at intervals, with the results shown in the following table:—

Jacket Temperature Overflow. Deg. Fahr.	Load.	Gas per Suction. Cubic Foot.
58–65	Nil.	0·1217
72*	Full.	0·1124
114	,,	0·1103
185	,,	0·1072
196*	Nil.	0·1117
185	,,	0·1141
179	,,	0·1159
61	,,	0·1205

It will be noted that the gas consumption varies between limits differing by 12 per cent.; and the indicated power would change in almost the same ratio. The author explained that the change in the consumption at and following the points marked with an asterisk was mainly due to the differences in the temperature of the piston which rapidly follow any change of load.

A number of tests were made with the object of determining the mechanical losses by finding the difference between the indicated and the brake horse power, and of comparing the result with that obtained from running the engine light under the same conditions. The engine was worked with a fairly full load, missing about one explosion in five cycles. The load was applied by means of rope brakes; and, as the test only lasted a short time, it was unnecessary to employ any water cooling. While careful observations were made of the brake load (the difference between a dead-weight and a spring balance), three photographs of indicator diagrams were taken, each photograph covering about a dozen explosions. At the same time the misses occurring in a couple of hundred cycles were counted, so that the ratio of missed ignitions to cycles was accurately known. These observations gave all the data for the mechanical efficiency; no observation of speed being necessary. The speed was, however, kept approximately constant by the governor at 180 revolutions per minute. The following are the results of measuring the three photographs, together with observations made at the time they were taken:—

Jacket Temperature at Exit. Deg. Fahr.	Explosions Cycles.	Mean Effective Pressure.	Gas per Suction. Cubic Foot.	Indicated Horse Power.	Brake Horse Power.
150	0·804	190·3	0·1196	39·7	34·0
—	0·820	99·4	0·1182	40·2	34·6
160	0·825	99·0	0·1164	40·2	34·9

It will be seen from these figures that the mean pressures from the three diagrams show very good agreement; being all within 1 per cent. of the mean value, after allowing for the small change in the charge of gas. The mean of the three observations of brake horse power is 34·5; and the mean indicated horse power is 40—giving a mechanical efficiency of 86·2 per cent. The difference between the brake and the indicated horse power ranges from 5·7 to 5·3 H.P.; the mean being 5·5 H.P. Immediately after the completion of the full-load tests, the brakes were taken off and the engine was run without load; the jacket-water being throttled so as to prevent the engine from cooling down rapidly. Photographs were taken of the indicator diagram, the gas consumption was measured, and the ratio of explosions to the total cycles was ascertained to be 0·141. The mean pressure was found to be 105·5 lbs. per square inch, and the gas consumption 0·1252 cubic foot; giving 7·35 I.H.P., or about 1·85 H.P. more than the difference between the moderated and the brake horse power in the full-load tests. Had the engine in the latter case been firing every time instead of four times out of five, this difference would have been increased in the ratio 5:4, becoming 2·3 H.P. This result—viz., that the power taken to turn the engine round at light load is rather over 2 H.P. more than the mechanical losses at full load, which was verified on many occasions—is due almost wholly to the difference in power absorbed by the pumping strokes of the engine at light and at full load. The author showed this graphically by a diagram in his paper.

An independent estimate of the power lost in pumping was made by belting the engine to the dynamo and motoring it round without allowing it to take gas. Two measurements were made—one immediately after the other. In one the engine was closed up as usual; in the other the exhaust-valve cover was removed, so that there was no pressure in the cylinder. Assuming the belt losses and friction losses to be the same in the two cases, the difference between the powers absorbed by the dynamo (after deducting losses) should be equal to the power absorbed in pumping. Two tests gave the following results; the jacket temperature in both cases being 180° Fahr.:—

	(1)	(2)
Engine closed	7·72	7·10
,, opened	4·14	3·77
Difference	3·58	3·33

The mean is 3·45 H.P., against 3·5 H.P. estimated from the indicator diagrams.

In comparing the mechanical loss with the light-load indicated power, care was taken that the conditions of the engine as regards lubrication and cylinder temperature were as nearly as possible the same. It was found that these factors make a very great difference to the engine friction; and it is important to allow for this in basing any estimate of indicated power upon that absorbed by the engine at light load. This point was strikingly illustrated by an experiment, particulars of which the author gave, made immediately after one of the tests for mechanical efficiency.

Confirmation of the great variation of power absorbed with the condition of the cylinder was obtained by motoring the engine round. The exhaust-valve cover was taken off the engine so that the cylinder was quite open to the air, and there was no loss from pumping. The power taken to drive the dynamo was measured electrically, and the dynamo losses were deducted, so that the following figures are the total frictional losses in the engine *plus* the loss in the belt (probably about 0·5 H.P.):—

		Power Absorbed.
Engine hot (about 180° Fahr.)	Normal lubrication	4·0 H.P.
,, cold (76° Fahr.)	,, ,,	6·5 ,,
,, ,, ,,	Excess of oil	4·7 ,,
,, ,, ,,	Water injected	2·7 ,,

A separate determination of the power required to drive the engine round with the piston removed was made, and it was found to be 1·4 H.P., including the main bearing friction, valve-lifting, and belt losses. Deducting this from the figures given above, the result is the piston friction, which, of course, is alone affected by the changes in cylinder temperature and lubrication. It will be seen that the friction varies, according to conditions, between 1·3 and 5·1 H.P.; the normal value with the jacket at 180° Fahr. being about 2·5 H.P. In normal working, at nearly full load (41 I.H.P.), the mechanical losses on the engine may be allocated as follows: Suction, 1·4 H.P.; piston friction, 2·5 H.P.; and other friction (valve-lifting, &c.), 1·1 H.P.—total, 5 H.P., or 3·4, 6·1, and 2·7 per cent. respectively of the indicated horse power.

The effect of using water as a lubricant when the cylinder is cold is easy to understand, though the author hardly expected to find that it was so great in amount as it really is. In one test, in which the engine was fully loaded and the jacket water was at a temperature of about 180° Fahr. at the exit, it was found that injection of water in considerable quantity diminished the number of explosions per minute by about 3 per cent. with the same brake

* An illustrated description of the indicator was given in an appendix to the paper.

load and speed. This difference was due entirely to the change of lubrication; the water having no effect whatever on the indicator diagram.

The following is a summary of the various efficiency figures relating to the engine used in the tests:—

Thermal efficiency	33½ to 37 per cent., according to strength of mixture.*
Mechanical efficiency for medium charge	85 to 90 per cent., according to jacket temperature.
Air-cycle efficiency	52·2 per cent.
Efficiency relative to air cycle	0·64 to 0·71 per cent.

* The weaker mixtures give the higher efficiency.

The following conclusions were arrived at by the author as the result of his investigations: (1) If precautions are taken to keep the pressure of the gas supply constant, the diagrams given by an engine are remarkably regular; and, whether the engine be missing ignitions or not, it is possible, by the use of a sufficiently accurate indicator, to obtain the indicated power from diagrams within 1 or 2 per cent. It seems probable that the difficulty experienced by the Committee of the Institution of Civil Engineers was due either to the essential defects, for this purpose, of the ordinary form of indicator, or to casual variations in the gas supply per suction—due, perhaps, to variation in the gas pressure at the engine. (2) The difference between indicated and brake horse power is rather less than the horse power at no load under the same conditions of lubrication, mainly because of the difference in the power absorbed in pumping. In the particular engine tested by the author, the error from this cause in obtaining the indicated power would amount to about 5 per cent. The friction is substantially constant from no load to full load, provided that the temperature of the cylinder walls is kept the same; but the influence of temperature is very great.

At the end of his paper, the author gave the results of a series of tests for mechanical efficiency made on a four-cylinder petrol motor working up to 1200 revolutions per minute. These were followed by three appendices—one, as already mentioned, containing a description of the indicator, and the others dealing with the conditions determining the gas and air taken per suction and the loss of heat in compression.

Discussion.

A hearty vote of thanks having, on the proposition of the President (Mr. T. Hurry Riches), been accorded to the author for his instructive paper, the discussion was opened, and continued until the time of closing the meeting, when it was adjourned. It was announced that consideration of the paper would be resumed at a special sitting to be held for the purpose a fortnight hence. It is only possible here to briefly indicate some of the points dealt with by the various speakers.

Professor ROBINSON remarked that the outstanding feature of the paper seemed to be the ingenious little indicator to which the author had drawn their attention. They had not yet quite got rid of vibrations; but doubtless, as was the case with every new instrument, there would soon be various improvements made. It would seem that the indicator was specially adapted for the engineering laboratory and the makers of engines. Looking at the results on the whole, they were interesting; but he thought that clearly for the present the rule laid down by the Institution of Civil Engineers for observing the efficiency and power of an engine by the brake, seemed to be the most reliable. The results given in the first table plainly showed that at the lower temperature of the cylinder more gas was taken in, and therefore more power developed per explosion. He should like the author to tell them what was the duration of time in each of these instances—how long was the temperature retained at one particular level? This applied all through the paper. It would be better if they knew how long the engine was working at each particular temperature. The author said: "The hotter the contents of the compression space, the less heat will be taken in from the cylinder walls during suction. The charge taken in after an explosion will therefore exceed that taken in after a scavenging stroke;" but it was added, "the cylinder and piston temperatures being the same." This condition was all-important. If this held good in practice, he would like to know why they had the great additional power obtained with a scavenging engine as compared with one that did not scavenge. As to water injection not affecting the indicator diagram, this might be true with gas-engines, but with oil-engines a very small amount of water injected into the cylinder produced a very great difference in the expansion. There was nothing very new about the results brought before them. They had had some similar ones before.

Professor F. W. BURSTALL said he very much regretted that Professor Hopkinson, in order to justify his optical indicator, had thought fit to throw discredit on every previous observer with indicators. The amount of work done on the Continent was enormous; and to say that such observers had been handling instruments with an error of 5 per cent., was too much for his credulity. He believed those gentlemen had known what they were doing. In support of his view, he quoted results obtained by Herr Meyer, who, he said, was acknowledged to be the greatest authority in Germany on gas-engine testing. He remarked that Professor Hopkinson said gas-engines were difficult to indicate; but there were far more difficult ones. He thought a great deal of the trouble with the pencil indicators was due to the "man who was behind the pencil." As to optical indicators, he believed they had a great future. They were extremely consistent.

Professor W. E. DALBY thought the indicator the author had brought before them was a step forward in the design of instruments for the purpose of dealing with explosion motors; but he was bound to say he still believed that the future lay with the diagram form of indicator rather than with the piston form. The method mentioned by Professor Hopkinson was only one of those recommended by the Committee of the Institution of Civil Engineers of indicating the horse power of an engine. There was another which he thought would give the efficiency of an engine within 1 per cent. without an indicator at all, providing the gas could be measured accurately; and the author's way of measuring the gas was so accurate that it seemed to him (Professor Dalby) that this would be a better way of arriving at the efficiency. Notwithstanding the small difference of opinion as to the form of the optical indicator, he was quite sure it was an instrument they would all find very useful, not only on gas-engines, but possibly on steam-engines as well.

Professor H. L. CALLENDAR remarked that as he had had personal experience with optical indicators he would deal with them. He was inclined to agree with the author about the ordinary indicator—at least when they were using rich charges in the engine which gave rise to very rapid explosions. In that case, he thought it was rather difficult to get accurate results. He did not agree with the statement that the Hospitallier-Carpentier monograph was "unsuited for accurate quantitative work for a number of reasons." Referring to another part of the paper, he said he was in agreement with the view that a gas-engine ought not, from a scientific point of view, to be tested with a hit-and-miss governor. It would be better to do it with throttling not only the gas but the mixture.

The discussion was then adjourned until Friday, the 1st prox.

BUYING COAL UNDER SPECIFICATION.

The American Society for Testing Materials recently had submitted to them a paper on this subject by Mr. J. E. Woodwell, and the "Iron and Coal Trades Review" has published an abstract of the communication, which is worthy of note for readers of the "JOURNAL," though not prepared exclusively from the gas makers' point of view.

The author pointed out that, with the present knowledge of the proper methods of burning coal, nearly all of the coals commercially obtainable may be utilized under appropriate conditions and with an equipment especially suited to the purpose, with a fair degree of efficiency—a proportionately equal return being secured from coals of lower grade. The use of many kinds of coal is dependent upon transportation rates; and certain coals are not applicable by reason of anti-smoke ordinances or regulations, though such restrictions are more often apparent than real, for with proper appliances many coals now rejected may be burned without producing objectionable smoke. Some coals are selected for their gas producing qualities, freedom from sulphur, &c., others for their coking properties.

It is within the province of the mechanical engineer to plan and install his equipment in order to utilize that coal or class of coal among those available which will produce the greatest return for the net cost. When the kind of coal has been decided upon, it is the duty of the purchasing agent to contract for that fuel under explicit terms which will be fair both to the producer or dealer and the consumer.

Ordinary Method of Purchase.

In the evolution of specifications for coal, the oldest and most familiar requirement is that the coal of specified name shall be delivered from a given mine or district of known reputation. Without other technical conditions, such a contract neither takes account of the inevitable variations in the quality of the coal in the designated mine or group of mines, nor does it recognize the important influence of methods of mining, cleaning, and sizing the coal upon its quality. Moreover, it is frequently not practicable either to secure the continuous delivery of coal from a given colliery or district throughout the life of a contract, or to determine the compliance with this single condition which forms the essence of the contract. Among the other defects which the plan of purchase upon the reputation of a mine has in common with nearly all other methods not based upon a specification covering calorific value and other features, is the lack of any definite basis for the rejection of unsatisfactory coal or for inferior coal necessarily consumed.

In practice, coals of the same class not only vary widely in different localities, but in the same mine; and these variations may result from differences in quality in the same or different beds, or in the methods employed in mining, cleaning, and sizing the coal. In the case of anthracite, it is often the practice to dump the output of a large number of mines, producing coal of different heating values and ash contents, into a central yard, from which it is shipped to dealers and consumers as a mixture. Under such conditions, uniformity cannot be expected; and when coal of the desired quality is secured, it is the result of chance. Even with the best intentions on the part of the operator or coal merchant, actual deliveries of coal purporting to represent the output of a given district or mine of reputation will frequently be

greatly at variance with the nominal standard accepted as the basis of a contract. To cite an illustration, a considerable quantity of coal actually furnished by a reputable dealer under terms of a carefully-drawn contract, in which the name of the coal bed from which deliveries were to be made was specified, actually contained over 40 per cent. of ash, as compared with an assumed ash content of 6 per cent.—resulting in a corresponding reduction of about 50 per cent. in heating value. Moreover, the coal passed the visual inspection of officers charged with the duty of checking the weights, and of noting the presence of slate, dirt, &c.

Purchase by Analysis.

Another plan is to purchase coal on the basis of a standard and guaranteed analysis, and to permit rejection if the variation from that standard exceeds certain established limits. The success of this plan depends to a considerable degree upon actually securing coal within the limits set for rejection; for in an important contract, or in the case of inadequate storage facilities requiring constant deliveries, the actual rejection of the coal might subject the purchaser to the greater loss due to delay and embarrassment in replacing the delivery, while a forced acceptance of the inferior coal without adjustment of price would in effect nullify the force of the contract. Furthermore, in the latter case no comparative basis of settlement would be provided in the event of a necessary substitution of another coal for the one specified.

Other specifications have been drawn on the basis of assigning limiting values in the proximate analysis. Another form also states the limits in the proximate analysis, but provides in addition for the adjustment of payments on the basis of certain variations from the standard analysis as set forth in detail.

Such contracts are usually drawn to include one or more specific kinds or grades of coal which have been found to operate with satisfactory economy under well-established plant conditions. With this object in view, such a specification precludes from competition many coals whose analysis approaches, if it does not regularly exceed, the limiting values.

Turning now from that class of contracts which are based entirely upon an analysis to the specifications which are based more strictly upon the thermal values of the fuel, there are many illustrations of the general recognition of the necessity of the B.Th.U. rating as contract standard.

Purchase by Thermal Value.

Some of the largest central stations and private corporations have adopted as a basis of coal purchase specifications involving the thermal values of the fuel. A specification typical of this class reads as follows:—

I. The company agrees to furnish and deliver to the consumer ..... at such times and in such quantities as ordered by the consumer for consumption at said premises during the term hereof, at the consumer's option, either or all of the kinds of coal described below; said coals to average the following assays:—

Kind of Coal.			
Of size passing through screen having circular perforations in diameter	—in.	—in.	—in.
Of size passing over a screen having circular perforations in diameter	—in.	—in.	—in.
Per cent. in moisture in coal as delivered . .	—	—	—
Per cent. of ash in coal as delivered . . .	—	—	—
B.Th.U. per pound of dry coal	—	—	—
From following county.	—	—	—
From following State	—	—	—

Coal of the above respective descriptions and specified assays (not average assays) to be hereinafter known as the contract grade of the respective kinds.

II. The consumer agrees to purchase from the company all of the coal required for consumption at said premises during the term of this contract, except as set forth in Paragraph III. below, and to pay the company for each ton of 2000 lbs. avoirdupois of coal delivered and accepted in accordance with all of the terms of this contract, at the following contract rate per ton of each respective contract grade, at which rates the company will deliver the following respective numbers of B.Th.U. for one cent, the contract guarantee.

Kind of Coal.	Contract Rate per Ton.	Contract Guarantee.
.....	Dol.	Equal to .. net B.Th.U. for 1c.
.....	Dol.	Equal to .. net B.Th.U. for 1c.
.....	Dol.	Equal to .. net B.Th.U. for 1c.

Said net B.Th.U. for one cent being in each case determined as follows: Multiply the number of B.Th.U. per pound of dry coal by the percentage of moisture (expressed in decimals). Subtract the product so found from the number of B.Th.U. per pound of dry coal. Multiply the remainder by 2000; and divide this product by the contract rate per ton (expressed in cents) *plus* one-half of the ash percentage (expressed as cents).

III. It is provided that the consumer may purchase for consumption at said premises coal other than herein contracted for for test purposes, it being understood that the total of such coal so purchased shall not exceed 5 per cent. of the total consumption during the term of this contract.

IV. It is understood that the company may deliver coal hereunder containing as high as 3 per cent. more ash and as high as 3 per cent. more moisture and as low as 500 fewer B.Th.U. per pound dry than specified above for contract grades.

V. Should any coal delivered hereunder contain more than the percentage of ash or moisture or fewer than the number of B.Th.U. per pound dry allowed under Paragraph IV. hereof, the consumer may, at his option, either accept or reject same.

VI. All coal accepted hereunder shall be paid for monthly at a price per ton determined by taking the average of the delivered values obtained from the analyses of all the samples taken during the month, said delivered value in each case being obtained as follows: Multiply the number of B.Th.U. delivered per pound of dry coal by the percentage of moisture delivered (expressed in decimals). Subtract the product so found from the number of B.Th.U. delivered per pound of dry coal. Multiply the remainder by 2000, and divide this product by the contract guarantee. From the quotient (expressed as dollars and cents), subtract half the ash percentage delivered (expressed as cents).

Another form of this kind in force at the time, and even more rigid in many particulars as applying to a particular kind of coal virtually specified, is of especial interest as indicating a full appreciation of the financial importance of safeguarding the interests of large consumers in the effort to secure the best thermal return for the expenditure. The contract requirements are drawn with a view to procuring a definite kind of coal described as a "good steam, coking, run-of-mine, bituminous coal, free from all dirt and excessive dust, a dry sample of which will approximate the company's standard in heat value and analysis, as follows."

Carbon.	71 per cent.
Volatile matter	20 ,,
Ash	9 ,,
	100
Sulphur	1·5
B.Th.U.	14,000

The price paid by the company per ton per lighter of coal, is based upon a table of heat values for excess or deficiency of its standard. This table places an arbitrary valuation of 1 c. for each 50 B.Th.U. excess or deficiency. [If this table is calculated in direct proportion to the price of the coal, that price would evidently be $2·82.] In addition to the corrections for heating value, determined by a Mahler bomb calorimeter, the price paid is subject to deductions for excess of ash, volatile matter, sulphur, or dust, or for shortage in the standard lighter quantity.

Volatile matter and ash are each penalized to the extent of 2 c. per ton for each one-half of 1 per cent. above the standard; while excess of sulphur is penalized to the extent of 6 c. per ton for the first quarter of 1 per cent. excess and 4 c. per ton for each succeeding quarter of 1 per cent. up to 2·5 per cent., above which a deduction of 20 c. per ton is made. A further deduction of 7 c. per ton is made if any lighter of coal delivered at the company's docks contains less than 700 tons.

With respect to business clauses, the contract is carefully drawn; and such subjects as bond, payments, deliveries, docking, towing, and demurrage, and method of sampling, testing, and arbitrating test results are all explicitly covered. The amount of coal consumed by this company—over 350,000 tons per annum, valued at about a million dollars—undoubtedly fully justifies such elaborate conditions.

U.S. Government Specifications.

For the average consumer, however, a much simpler form, involving corrections for variation in heat units and ash only, may afford adequate protection. As a result of experience gained in the purchase and testing of coal for the Government buildings located in all parts of America, combined with the broad technical knowledge of the subject gained by the fuel-testing division of the United States Geological Survey, which, under the direction of Mr. J. A. Holmes, has actively and most effectively co-operated in the matter, a broad contract form has been developed. After its preliminary preparation, it was carefully reviewed by prominent coal dealers, engineers, private corporations, and others interested in the subject, who, as a rule, adjudged it to be fair and just to both parties. A meeting of the National Advisory Board for Fuels and Structural Materials, appointed by the President, was then called to consider the subject; and after certain modifications in form and arrangement, its adoption was recommended. The specification is drawn up so as to enable users to describe the coal desired, which may be anthracite or bituminous, and in the latter case with such proportion of volatile matter as will include either eastern or western varieties as may be demanded. Unlike some of the specifications which have been drawn with special reference to a particular kind of coal, this form has been made sufficiently flexible to meet the varying requirements due to different locations throughout the United States, and also the special needs of the local equipment.

Under this plan also bids may be secured for a number of classes of coal procurable in a given market, and then compared with a view to selecting the one showing the highest economic value. What is actually desired is not necessarily the cheapest or the highest grade of coal *per se*, but the coal which will insure the greatest net economy in plant operation; and to attain this object it appears undesirable to establish an absolute standard for the fuel, which would tend to limit the sources of supply.

It is intended to establish limits which are wide enough in any case to permit the use of the output of any mine or group of mines, providing proper care is exercised in mining and picking out slate, stone, &c. With these points in mind, it is only necessary for the bidder to select coal for his purpose which will meet the description given, and permit deliveries within the limits set. The bidder is also required to state the heating value of the coal, as delivered, in B.Th.U., and the percentage of ash in dry coal, with a view to the use of such statements as a basis for payment

in connection with the stated price per ton. It is expected that the standard thus established by the contractors will be such as to require the least correction applying to deliveries for variations in B.Th.U. and ash; but it is not expected that all deliveries will be absolutely uniform or agree exactly with the standard. It is necessary, however, that all deliveries shall be within fixed maximum limits.

Corrections.

The heating value, expressed in B.Th.U., of coal containing approximately the same percentage of ash is essentially a direct measure of the actual value to the purchaser; and for this reason the specifications provide for an adjustment of payment in direct proportion to the variation in heat units in the coal as received. As the coal is weighed when delivered, and the payments are based also upon the price per ton, it is necessary to determine the heating value of the coal in the condition in which it is received, containing whatever moisture may be present at the time. A further correction in payment will be made for variation of the ash in dry coal, in order to take account of the cost of handling additional fuel and ash and its effect on the capacity of the boiler and furnace.

The system of sampling, analyzing, and testing coal delivered under the Government contracts will be under the supervision of the fuel testing division of the United States Geological Survey, in order to insure reliability and impartiality.

The application of this system will not only enable the award of a contract to be made in an equitable manner, but will also remove many of the usual causes for dispute as to the character and quality of the coal subsequently delivered, and provide a satisfactory basis for the adjustment of payments for differences in quality in favour of the party in whose interest it is due.

It is believed that the enforcement of the provisions of the specifications will operate equitably both with respect to the Government and to the contractor, inasmuch as a premium is provided as penalty, and will guarantee adequate protection to each party.

As to the necessity for some such system, experience in applying a specification which penalizes a deficiency in heating value only, has developed an average deficiency of about 3·5 per cent., which on contracts aggregating $200,000 represents the sum of $7000, of which not more than $1000 can be charged for testing. Individual deliveries have in practice, as mentioned before, shown as high as 47 per cent. of ash on a contract standard of about 6 per cent., and less than one-half of the stipulated heating value. Under the accompanying specifications coal of this sort would be subject to rejection, or, if used, would not command a payment adequate to reimburse the contractor for the cost of cartage alone. It is also doubtful if such coal is of sufficient value to the user to repay the cost of firing and the subsequent handling of ashes.

This system of coal purchase has been established by the Government for economic gain; and it has been applied therefore with discrimination as to the size of the contract which will warrant such procedure. In general, it has been justified practically on contracts exceeding $2000 in value, though other factors than price frequently influence the choice of methods of purchase, such as limited competition, availability of coal market, &c.

Experience in the use of this method shows that frequently the correction for moisture influences the heating values of coal quite as much as variation in the ash content. In adjusting payment, therefore, on the basis of the coal as received by the consumer, the brunt of the proposition is thrown upon the dealer, who should make conservative allowance for probable variations in establishing the contract standard.

In certain instances, bidders have submitted samples of coal with bids, with a view to using the results of analysis and test as a contract guarantee. In such cases, under the stress of competition in quality, as well as price of the coal, it is to be expected that a sample would be of exceptional rather than average quality. In other instances, in which the contract liability assumed in stating heating values has developed a lack of knowledge of the performance of the fuel on the part of the bidder, the contract standard is so underrated as to result in a continuous increase in price by the payment of premiums.

In conclusion, it seems proper to emphasize the importance of bringing about a better understanding between the producer and the consumer, in order that the coal operator may understand how to market his product directly or through a local dealer with reference to the intrinsic value to the user—*i.e.*, the thermal and economic values of the fuel. The general application of this specification depends upon the co-operation between the mine operator and the dealer; so that the operator may receive the benefit from high quality, and stand for the loss due to shipment of inferior coal. The success of this method also depends in a large measure upon the knowledge possessed by the mine operator or dealer of the characteristics of the coal handled and upon the ability to control the variations in quality due to methods of mining and cleaning.

Lecture by Professor Lewes for the Gaslight and Coke Company.—At the offices of the Gaslight and Coke Company, Horseferry Road, Westminster, at half-past six this evening, Professor Vivian B. Lewes, F.I.C., F.C.S., will deliver a lecture on "The Hygiene of Gas."

HIGH-PRESSURE DISTRIBUTION IN AMERICA.

By E. C. Jones, of San Francisco.

[A Paper read before the Pacific Coast Gas Association.]

The rapid growth of the suburbs of San Francisco towards the south presents an alluring field for high-pressure gas distribution. The city is situated at the end of a peninsula, bounded on the north by the bay of San Francisco and the Pacific Ocean, on the east by the bay, on the west by the Pacific Ocean, and on the south by a chain of beautiful suburban towns, extending as far as San Jose, 50 miles away. These towns are protected from the winds and fogs which tend to make San Francisco an unpleasant dwelling-place; and the climatic conditions are such that, as we go south from the city, we enter a veritable garden spot with semi-tropical vegetation, and every attraction to the suburban resident, including excellent railroad facilities, both steam and electric.

In the early days of gas lighting on the coast, there were small coal-gas works at San Mateo, 21 miles from San Francisco; and later on an oil-gas plant was built at Redwood City. After the usefulness of high-pressure systems had been demonstrated, a line consisting of 2½-inch extra heavy pipe, with line-pipe sockets, was laid from Redwood City to San Mateo, a distance of 8·2 miles. On this pipe a pressure of from 10 lbs. to 30 lbs. is maintained, depending upon the demand for gas. This line feeds into a high-pressure district in San Mateo, including 63,490 feet of 1-inch and 2-inch pipe. The consumers in this town are served with gas through high-pressure regulators at the inlet of each meter. This permitted the shutting down and dismantling of the San Mateo Gas-Works. A high-pressure system was also installed at Redwood City, consisting of 5410 feet of steel pipe in small sizes. This is used in conjunction with a low-pressure system fed from the gas-works by one governor, reducing the pressure to 4 inches of water. The work of compressing the oil gas was performed by a steam-driven compressor, with suitable governors for regulating the high pressure of San Mateo and the high and low pressure mains of Redwood City.

During the early part of 1905, Palo Alto, a city of 4500 inhabitants, located 5 miles south of Redwood City, was piped for gas with small high-pressure mains, and using individual governors. The work was done by the Palo Alto Gas Company, who purchased their gas from the Redwood City works. To supply this district, 3-inch steel tubing, 26,365 feet in length, was laid in the country road, and four storage tanks, 29 ft. 6 in. long by 4 ft. 6 in. diameter, were installed at the Palo Alto end of the line. This installation was completed on May 11, 1905.

In casting about for a suitable place for the storage-tanks at Palo Alto, it occurred to the writer that it was not necessary to purchase or rent real estate for the purpose of locating tanks above ground, as many gas companies all over the world are occupying the streets with mains of greater diameter than these tanks. They were therefore put underground in a tandem sequence closely surrounded by earth; while the regulators occupy spaces between the tanks in neat boxes with covers flush with the surface of the ground—an arrangement which is safe, inoffensive, and economical. This line is worked under pressures of 40 to 60 lbs.; and to ensure continuous service, it became necessary to instal an electrically operated compressor at the Redwood City plant, retaining a gas-engine driven compressor as a reserve.

To improve the service, and to permit of better regulation, a storage tank was installed at the Redwood City works; and into this all the gas used by the city, San Mateo, and Palo Alto was pumped. The gas was liberated through separate governors giving to each of the three places the required pressure. At that time the effect of compression on candle power was being widely discussed and was but little understood. All that was known was that the illuminating value of the gas suffered almost in direct proportion to the increase in pressure.

It was evident that the raising of the pressure to 60 lbs. on the Palo Alto line reduced the candle power 4·6 candles. The compression liquid, depending in quantity on thermal conditions and the amount of pressure, was being drawn out of the drips on the line. This liquid consisted of water, naphthalene, and a high grade of benzol. The last represented the cream of the candle power of the gas, and consisted of the least staple and most sensitive hydrocarbons which were squeezed out by compression.

The writer inferred that the gas compressed at 60 lbs. was nearly free from water, and was therefore in the best condition to readily and quickly take back into itself the hydrocarbons which had been pressed out of it; also that the hydrocarbons would more readily be taken up and again enter into the composition of the gas than the water would be, because benzol evaporates so much more readily than water.

The physical changes in the gas due to compression and to the restoration of the candle power are in the following sequence: The compressor squeezes out the water and some of the hydrocarbons; and in order to replace the hydrocarbons it becomes necessary to keep the gas in intimate contact with the fluid resulting from compression. To do this the writer designed an extremely simple piece of apparatus, and gave it the name of "auto-enricher." It is a simple cylinder, preferably of large size, into which all the compressed gas and the fluid of compression as they come from the compressor, enter at one end at the top, and the gas is taken out at the other end at the top, care

being exercised that the passage of the gas is slow, and that none of the liquid is allowed to escape from the auto-enricher except as it is taken up by the gas. Such a re-enriching tank was placed underground at the Redwood City plant, with the result that the candle power at San Mateo, Redwood City, and Palo Alto was restored to its original condition before compression.

Further experiments, which were subsequently made the subject of a paper by the writer, read before the American Gas Institute,* proved that, by raising the compression, certain physical changes took place in the gas, until at 300 lbs. pressure the gas was completely purified from sulphuretted hydrogen and naphthalene; these going down with the compression fluid, and not reappearing in the gas when the benzol is taken up by it in the re-enriching tank.

In 1905, the largest oil-gas plant in the world was designed and constructed, on new lines, at a point on the bay of San Francisco in San Mateo County, in close proximity to the San Francisco border line, and was named, after our President, the Martin station. This plant was built for the purpose of supplying gas to a number of large engines for directly generating electricity. Before the completion of these engines, the gas-generating plant was finished and started.

To utilize this enormous plant, 12-inch steel tubing was run along the country roads into San Francisco, and connected with the works of the Gas and Electric Company at the Potrero station. The length of this line is 4½ miles, and a stream-driven compressor was used for transferring the gas. This proved so satisfactory that it became the nucleus of the largest compression plant in existence for manufactured gas. Two power-driven compressors were installed, each having a capacity of 5½ million cubic feet of gas in 24 hours. Following the growth of this plant, the gas-engines, three in number, each of 5·333 H.P., were completed and successfully started. Between the Martin station and the south is the high ridge of the San Bruno Mountains, but west from the station there is a gap through the range, which permits of a practically level outlet into the roads leading from San Francisco down the peninsula to the south.

It required the earthquake, which is not yet effaced from our memory, to bring out the fact that the Martin station is a desirable point from which to supply gas to the cities and towns of the peninsula through high-pressure mains. The peninsula towns were directly in the path of the earthquake's greatest destruction; but as the high-pressure mains and nearly all the ordinary mains in this section were of wrought iron, not the slightest damage was done to the distributing system. This is true of all the high-pressure systems in California. No wrought-iron pipe was broken, and no joints were disturbed. The Redwood City Gas-Works, however, did not fare so well. The boiler-settings were badly damaged, and the gas-generating apparatus was moved several inches on its foundation; while all the cast-iron connections were more or less damaged. A 20,000 cubic feet gasholder, in a wooden tank, was completely demolished. This adjustment of matters by the earthquake made it much easier to decide to supply the district from the Martin station.

On Feb. 23, last, the work of laying 4-inch steel tubing (3·7 inches inside diameter) from the station to Redwood City, a distance of 23·73 miles, was begun. The pipe passes through the following suburban towns, all of which receive gas from it: Burlingame, population 900; San Mateo, 4600; Belmont, 500; Redwood City, 2500; Fair Oaks, 250, and the Palo Alto extension, including Menlo Park, 1200; and Palo Alto, 4500—making a total population of 14,450.

This high-pressure line was laid with Dresser couplings, using rubber gaskets; the flanges of the joints being drawn up tightly and evenly to prevent as much as possible the contact of the gas with the rubber. It is quite important, in using this patent coupling, that the tightening of the bolts shall proceed evenly, so that the flanges may remain parallel. Should one side of the flange be drawn up more than another, the pressure on the rubber gasket is uneven, and the flange is apt to bind on the pipe, so that a leak is almost certain.

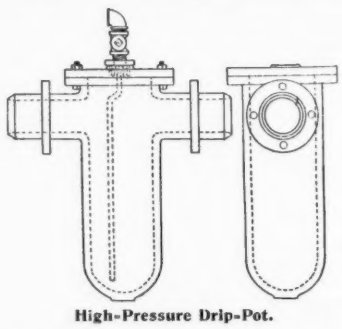
The painting of this line was a matter of some study, as it had previously been found that red lead and linseed oil of the best quality, though offering a good protection to the pipe, would not withstand the attacks of either the air or the soil. This pipe was therefore first thoroughly cleaned and painted with one coat of red lead and oil, and then given a second coat of good and well-proved metallic gasholder paint which dries with a hard, shiny finish.

A new pattern of drip-box was used on this line, and 25 of them were located at various low points throughout the length of the pipe. High-pressure valves made for the purpose of holding ammonia were placed in a line at five different points at the approach of each town. These valves were connected into the line by means of an adapter, to permit the connecting of a Dresser coupling with a flanged valve. The drip-box is provided with half a Dresser coupling on each side, to facilitate its being connected into the line. The drip-box and the adapter are shown in the accompanying illustrations.

No other fittings are used on this line with the exception of six crosses, one at each town. They are provided with adapters to Dresser couplings, and all right angles are turned by bending the pipe at a uniform radius of 20 feet.

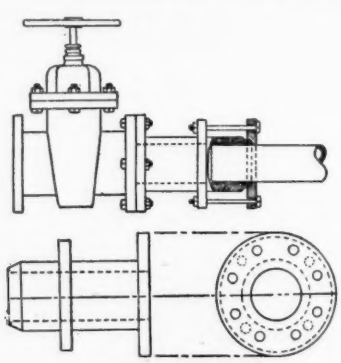
At the completion of each day's work, the line was capped, and air pressure applied to it up to 100 lbs. to the square inch. This pressure was allowed to remain on the line the entire night. Testing for small leaks was done by the use of soapsuds applied with a brush to all parts of the coupling and to the pipe for a distance of 2 feet on each side of the coupling, as this seems to be the vulnerable place where the pipe is apt to be split. The importance of careful testing is evident when it is stated that no less than 182 defective sleeves and 29 lengths of split pipe were discarded on this line.

The line was completed on the 1st of June last. The actual working days required were 75. The average length of pipe laid each day was 1660 feet; while the greatest quantity laid in a single day was 3200 feet. The average depth of the pipe is 2 ft. 6 in. The line was brought into use on the 18th of July; and not a single leak has developed in any part of it. The gas, which is first forced through an auto-enricher, is pumped into the pipe by a 14 in. by 16 in. by 12 in. steam-driven compressor, with a mechanical efficiency of 85 per cent. and requiring 55 H.P. to drive it, under the present working conditions. This compressor



High-Pressure Drip-Pot.

has a capacity of about 22,500 cubic feet per hour. The auto-enrichers are 6 feet diameter and 32 feet long, and have a capacity of 875 cubic feet; that of the line itself being 9375 cubic feet. The 25 drips on the line have a combined capacity of 19 cubic feet; and that of the receiving-tank at Redwood City is 380 cubic feet. The total capacity of the tanks and line is 11,524 cubic feet. The gas is received at Redwood City into a storage-tank 5 feet in diameter and 26 feet long. It is used for receiving all the gas, and from it the various lines are fed through governors. It is taken from the tank and pumped by means of a motor-driven compressor into four storage-tanks at a pressure of 80 lbs. per square inch. This boosting arrangement is a temporary expedient for present convenience, and is capable of many changes, as the tanks may be filled directly from the line, and discharged automatically through the existing governors whenever there is a drop in the pressure. Just now, approximately 100,000 cubic feet of gas per 24 hours are consumed through the Redwood City high-pressure line; and the line is so free from defects, and its storage capacity and that of the three tanks (disregarding the four storage tanks at Redwood City) is so large, that the compressor



Adapter in Position.

at the Martin station is only operated a portion of the time. For instance, on Aug. 30, which was an average day, it was worked from 8 a.m., when the pressure was 53 lbs., until 10.30 p.m., at a pressure of 66 lbs. It was then shut down until 6.30 a.m., when the pressure was 50 lbs., and was operated until 8 a.m. at a pressure of 55 lbs. On this day the compressor was run for a total of 16 hours; and the greatest variation in pressure was 16 lbs. The drop was gradual from 10.30 p.m. from 66 lbs. until 6 a.m., when the pressure reached 55 lbs. From 6 to 6.30 a.m. it dropped 5 lbs.; showing that the consumption of gas for the "breakfast peak" reduced the pressure 5 lbs. in 30 minutes.

The pressure at Redwood City coincides with the pressure at the Martin station. For instance, at noon, on Aug. 11, at both places it was 50 lbs. At 1 p.m. the compressor was started with 45 lbs. pressure at each point, and operated until 4 p.m., when the pressure was 55 lbs. The compressor was then stopped until 6 p.m., and the pressure was 50 lbs. At 10.30 p.m. the compressor was shut down with 65 lbs. The compressor was then shut down till 7.10 a.m., when the pressure at each point was 55 lbs. All

* See "JOURNAL," Vol. XCVI., p. 448.

these pressures were the same at both ends of the line. This coincidence of pressure may be accounted for by the comparatively large capacity of the line and the small consumption of gas. This is an argument in favour of large, high-pressure transmission lines, and of the greatest care being exercised in their installation to ensure tightness.

This line completely installed cost 1½ times as much as a 2-inch outside diameter line, which would have an actual inside diameter of 1·782 inches. It has a holding capacity 4·3 times as great as a 2-inch line; and its carrying capacity, at equal pressures, is 5·75 times that of such a line. The installation is large enough to provide for the growth of the southern suburbs of San Francisco for many years, and will ensure excellent service to the best class of gas consumers. The average monthly consumption per meter of these consumers is 4570 cubic feet, which is in excess of that of most large cities in America.

In conclusion, the writer may be permitted to apply a very old saying to high-pressure gas distribution—that, like fire, it is a good servant but a bad master.

FUEL BRIQUETTE MAKING AT DETROIT.

At the recent meeting of the Michigan Gas Association, Mr. W. S. Blauvelt, of the Solvay Process Company, Detroit, submitted a short paper in which he furnished some particulars in regard to the progress of fuel briquette manufacture at the works of his Company in that town. The following are extracts.

Early in 1904, the Solvay Process Company determined to instal a briquetting plant at their Detroit works, in connection with the coke-oven plant. At that time the price of tar was very low, and there was no market for coke breeze except at a very low price. Anthracite coal was selling at from $7 to $7·50 per ton, according to the season of the year; and all the coke made by the Gas Company and the coke-ovens of the Solvay Process Company was being sold as fast as it was produced. Thus, having ample supplies of raw materials and reasonable assurances of a good market for a high-grade domestic fuel, conditions seemed peculiarly favourable for the commercial success of the venture.

At first plant of the kind used in England was employed; but this was found to be too large. Accordingly, it was decided to instal an American-built machine of the eggette type, capable of producing from 9 to 15 tons per hour of briquettes weighing 2½ oz. each. The machine was put up and the plant completed about Aug. 10 last, since which date it has been in use daily.

In the operation as carried on at the Detroit works, the raw materials used are bituminous coal, coke breeze, and hard pitch. The breeze is coke screenings which pass through ½ inch square openings. As the breeze received is generally quite wet, it was found necessary to dry it before it could be used. A rotary dryer, having a capacity of about 6 tons per hour, was therefore installed; and with it the moisture was reduced from 15 to less than 1 per cent. The pitch binder used is broken in a roll crusher to about the size of chestnut coal, and then elevated to a small bin.

The pitch, breeze, and coal are fed by suitable measuring devices from their respective bins to a pulverizer of the swing-hammer type, which reduces the size of the pieces till practically all will pass through a screen with ⅛ inch square openings, and also produces a very intimate mixture of the different materials. The pulverized mixture is then elevated and delivered to an inclined rotary heating conveyor, into which steam is introduced. In this conveyor the mixture is heated to about 170° Fahr., at which temperature the mixture begins to be somewhat plastic; but, being in constant motion, and having no pressure applied, it does not become sticky or clog the conveyor.

From the lower end of the conveyor the mixture falls into a ribbon screw conveyor, where more steam and a little water, heated nearly to boiling-point, are added. If no water be added, the mixture becomes very sticky and difficult to handle, and the power required to run both conveyor and press is excessive. The ribbon conveyor delivers the mixture, heated to about 200° Fahr., now in the form of a wet plastic mass, to a shoot directly over the rolls of the press.

The press itself consists essentially of two heavy cylindrical rolls having cup-shaped moulds on the surface. These rolls are geared together so that the moulds on the two rolls register as they rotate. The plastic mass being fed on top of the rolls fills these moulds, and the material is compressed as it passes down between the rotating rolls. This press, running at its present speed (six revolutions per minute), has a capacity of 9 tons per hour; but there seems no reason why it could not be speeded up to produce 15 tons. The briquettes fall out of the moulds, as the rolls revolve, on to a belt conveyor, where they are cooled sufficiently to withstand handling. From the end of this conveyor they are delivered over a screening shoot direct to cars for shipment.

After a long period of constant study and labour, the technical problems connected with the manufacture of fuel briquettes for domestic use, from the materials available, have apparently been successfully solved. The briquettes produced are hard and tough enough to stand considerable rough usage; they do not disintegrate on exposure to the weather; they burn with very much less smoke than smokeless coals, and produce no smoke whatever except for a very few minutes immediately after being thrown on to the fire; finally, they do not fuse together in burning, and burn up completely, leaving practically no carbon in the ash.

Experience has shown that the successful manufacture of good briquettes is dependent very largely upon using the proper proportions of pitch and other materials. The percentage of pitch necessary is also found to vary somewhat with different kinds of coal; and this must generally be determined experimentally. It is of prime importance that the mixture, once determined upon, should be kept uniform, as very slight changes in the quantities of the materials have a marked effect upon the quality of the finished product.

REPAIRING A GASHOLDER CUP.

By G. S. Colquhoun, of San Francisco.

[A Paper read before the Pacific Coast Gas Association.]

There is at the Potrero station of the San Francisco Gas and Electric Company a 500,000 cubic feet two-lift holder, used for storage purposes, which was built in 1874; and the grip on the lower lift of the holder had, from long use, become badly corroded just above the water-line of the cup. The leaks had from time to time been stopped with soft patches, using an iron clamp with red-lead putty between; but they eventually became so large and numerous that it was decided to renew the whole row of sheets on the channel-iron forming the grip. The holder is built in a concrete masonry tank, and the water-level is about 2 inches below the top of the lower lift when it is down. This necessitated the lowering of the water in order that the men could work.

A "block-and-falls" was rigged up to each of the guide-frame uprights, with a hook on the lower end reaching down and under the grip sheet, in order to hold this and the channel-iron from falling after they had been cut loose from the lower lift. The men were then set to work in pairs to cut the rivet heads—one using a side cutter and the other a light sledge hammer. After the heads were cut off, some difficulty was experienced in driving the rivets through without injuring the top sheets of the lower lift; but, after some experimenting, it was found best to ease the sheets away from the channel-iron. For this work each man used two long slim-taper cold chisels, driving one down between two rivets, and leaving it there until the other had been forced down between the next two; then drawing the first one, and driving it ahead of the second chisel. This loosened the sheets without the danger of tearing them.

When the lift sheets were all loosened, the channel-iron and grip sheets were raised by means of the blocks and falls about 3 feet above the ground. The sheets were marked as to their position on the channel-iron, as it was found that the holes were not equally spaced, nor were they in line horizontally, so that each new sheet would have to be marked from the old one as a template. After this was done, the rivets that held them to the channel-iron were cut in the manner already mentioned.

In putting on the sheets, red-lead paint and putty were used in the joint, and 5·16ths inch and 1½-inch machine bolts, with a grummet on the head, to fix the new sheets to the channel-iron; the bolts being put through from the under side, leaving the nut on the outside. The vertical seams were riveted, as was also the bottom stiffening-rod. While the grip sheets were being bolted in place, some of the men were set to tapping the holes in the outer side of the channel-iron for 1½-inch cap screws; and the holes in the top sheets of the lower lift were reamered, so there would be a little clearance round the sides of the cap screws. This work being completed, the channel-iron, with the new grip sheet, was lowered into position, and cap screws put in about 1 foot apart all round the holder. Then the spaces were filled in with cap screws; red-lead putty being used in the joint. It required 4000 machine bolts, a like number of ½ inch by ¾ inch cap screws, and a strip of ⅛-inch iron, 14 inches wide and 350 feet long, to do the job. The top lift of the holder was in operation continually.

While repairing the holder, there was a peculiar accident which very nearly wrecked the top lift. Within a few feet of the holder is another of the same size and kind, and a cement-lined overflow which keeps the water-level the same in both holders. I mentioned above that the water-level in the holder under repair was lowered; and in order to stop the water from coming from the relief to the storage, the connection between the two holders was banked up with clay. When the channel-iron and grip sheets were raised from the lower lift, it was found that the water was about 2 inches higher on the inside than on the outside of the lower lift—showing that the lower lift was setting in mud sufficiently thick to keep the water from equalizing at once—in fact, it took nearly a week for the water to find its level.

One night, after the water had become level on both sides, the clay dam between the holders gave way, and allowed the water from the relief holder to rush in. There being nothing to stiffen the bottom lift, and the mud below keeping the water from assuming the same level on both sides, the top sheets of the outer lift were buckled in against the top lift from the pressure of the water on the outside. When the top lift came down, it caught on a horizontal seam, and tore a hole 5 feet long by 2 ft. 6 in. wide in the side of the top lift.

In making the second repairs, after the bent top sheets of the

lower lift had been tied back, the work of repairing the upper lift was begun. A sheet of No. 12 iron, 3 ft. by 6 ft., was secured, and 5-16ths inch holes were punched 2 inches apart all round the edge. Bolts were made by cutting the heads from machine bolts and bending them to about 1 inch to 90; leaving 1½ inches on the thread side—the threads being run down to the bend. The sheet was then placed against the holder over the hole, with red-lead putty between, and a hole drilled every 8 inches with a breast drill, and the bolts put in. The nuts were screwed tight; the bolt being held outside the nut with a pair of pliers. The holder was then raised slowly, and bolts put in 4 inches apart on the vertical seam until the bottom of the patch was reached, when there was some trouble to stop the gas. But, by quick work and the use of some putty, sufficient bolts were put in to make tight. There was then no trouble in putting in the rest of them.

GAS OIL IN GERMANY.

At the last meeting of the German Gas Association held at Mannheim during the past summer an interesting discussion took place on the different aspects of the gas oil industry and market in Germany. The subject was opened by a paper read by Dr. Schütte, of Bremen, who sketched at some length the growth of water-gas manufacture in various countries where import taxes or the absence of a home supply of oil did not restrict the volume of carburetted water gas made. From the report of the communication and subsequent discussion printed in the "Journal für Gasbeleuchtung," we have obtained the following particulars.

Dr. Schütte stated that some six or seven years ago there were hardly any water-gas plants at work in Germany, but that the number had now increased to about fifty, capable of producing about 35 million cubic feet per day. During 1905, only about 1000 million cubic feet of carburetted water gas were made—a figure which included water gas carburetted both by the hot and by the cold process. The reason why the manufacture of water gas in Germany had lagged behind that of other countries was the difficulty of obtaining supplies of gas oil. Practically, the whole of the oil had to be imported; and originally oils having a higher specific gravity than ·830 had to pay import duty at the rate of 10 marks per 100 kilos. gross. At the beginning of 1903, a change was made in the law; an oil having a density lying between ·830 and ·880 at 15° C., intended for use as a motor fuel or for carburetting water gas, being admitted at the reduced tax of 3 marks per 100 kilos.

The amount of crude petroleum won throughout the world in the year 1906 was roughly 28 million tons, 16 million tons of which were obtained in the United States, 8 millions in Russia, 1,350,000 tons in the Dutch Indies, 887,000 tons in Roumania, 760,000 tons in Galicia, 560,000 tons in British India, 80,000 tons in Germany, and 265,000 tons in other places. It was not possible, Herr Schütte remarked, to say how much gas oil was made from these 28 million tons of crude petroleum, for some varieties yielded only 10 per cent. of gas oil, while others gave 40 per cent. Nevertheless it might be said that the consumption of gas oil in America was about 600,000 tons; while that of England was 220,000 tons in 1906. The amount of gas oil imported into Germany for the year ending March, 1907, was 4153 metric tons.

Of the 80,000 tons of crude petroleum raised in Germany, about 58,000 tons were derived from different wells in the neighbourhood of Wietze, a village on the Lüneburg Heath, in the province of Hanover; while 21,000 tons came from Pechelbronn, near Sulz, in Alsace. The quantity of gas oil recovered from this material was very small, for the bulk of it was worked up into lubricating oil. On the other hand, other oils were used for carburetting water gas besides that obtained from petroleum—*e.g.*, oils recovered on distilling brown coal, and also the tar left on treating bituminous shale. The oils derived from these raw materials, however, were chiefly consumed in the manufacture of oil gas and the mixed gas used by the railways, whose consumption amounted to some 12,000 to 13,000 tons per year. Hence the gas industry of Germany was almost wholly dependent upon foreign sources for its supply of gas oil. When the import tax was reduced, the effect was chiefly felt in Galicia and Roumania; but the cost of carriage from Roumania was so high, and so much of the oil refined in that country had a higher specific gravity than ·880, that Galicia was left the only source of supply. Of late years the Galician gas-oil market had changed in a very unexpected fashion. Before the new tariff, gas oil could be obtained at the frontier for from 3·50 to 4 marks per 100 kilos.; but now the price had risen to 6 or 7 marks, so that it cost from 11·50 to 12·50 marks delivered at the place of consumption in Germany. This rise in price was partially explained by the fact that the consumption in Austria had gradually increased, and partly by the owners of the refining works in Galicia being nearly all members of a trade combination. On the whole, therefore, Dr. Schütte felt that the manufacture of oil-carburetted water gas in Germany was in a somewhat precarious state, and endeavours would have to be made to cheapen gas oils or else the construction of water-gas plants would have to be abandoned.

With the object of cheapening gas oil, the speaker thought that the law ought to be altered so as to make the maximum specific gravity ·890 instead of ·880, which would enable the Roumanian refiners to enter the German market. The same remark applied to the United States; and Dr. Schütte hoped that the provisional arrangement with the States, which lapsed at the end of next June, would be replaced by a permanent treaty admitting American gas oil into the country at a low rate. Herr Schütte failed to see that the tax on gas oil was necessary for the existence of the German mineral oil industry, inasmuch as the members of the latter were wholly incapable of supplying the oil required by gas-works. In his opinion, it would be preferable to admit refined gas oil into the country without tax rather than to remove the import duty on crude petroleum. In many respects, of course, it seemed undesirable that a higher import duty should be imposed upon a crude material than upon a refined product; for if the tax on crude petroleum were greatly reduced or removed, an important industry might grow up in Germany to the advantage of chemists and engineers alike. Nevertheless, the speaker preferred the idea of reducing the tax upon gas oil; for if the material were to be refined in Germany, he feared that a trade combination or a monopolization of the business would arise, leading to a serious increase in the selling price of all the refined products. This was what had happened in France. Again, if the importation of crude petroleum into Germany were encouraged, large quantities of residues would be produced locally, and a market would have to be found for them within the country or else they would have to be exported again. In either case great expense would be incurred which would render the refining in Germany unremunerative. Another method of cheapening gas oil was the creation of an associated purchasing agency. Such an enterprise had recently been formed, and was likely very considerably to benefit the gas industry of the country.

At the close of Herr Schütte's paper, Professor Bunte rose to express his disagreement with the author's remarks on the subject of refining crude petroleum in Germany. Dr. Bunte admitted that if the paraffin oil used as a fuel in Germany were refined within the Empire, from four to five times its quantity of crude oil must be imported; but since the bye-products obtained in making this lamp oil—*i.e.*, three-quarters or two-thirds of the crude petroleum—were precisely the grades of material which were required for making into gas, for carburetting water gas, for consumption in motors and heating appliances, the distillation of crude petroleum in Germany would create a new industry of very large proportions. Dr. Bunte did not ask that all lamp oil should be refined in Germany, feeling that the advantages would lie with a system whereby some of it was imported before and some after appropriate distillation. The imposition of an import tax was, of course, only a financial move; and the speaker failed to understand why a raw material should be penalized, according to the amount of refined products it contained, so heavily that it could not be worked up or purified in the country. The German Gas Association had already tried to persuade the Government to allow gas-works to import oil in bond under such regulations that only the oil used in carburetting water gas should escape tax. The project had failed; but Dr. Bunte suggested that the Council should once again consider whether steps might not be taken to attain the desired object.

Dr. Spiegel, of Messel, near Darmstadt, next rose to address the meeting from the aspect, not of a gas engineer, but of a salesman of mineral oil. From his standpoint he naturally regarded Dr. Schütte's remarks as being very one-sided. There were other industries in Germany besides that of gas manufacture which had to be considered. The State was in sore need of money, and would not be willing to remove the whole of the tax upon petroleum. Indeed, the German mineral oil industry had really only attained the dimensions it exhibited by reason of the tax; and its removal would ruin the trade. [This observation was received with marks of much incredulity.] Dr. Spiegel desired to contradict the assertion that when the needs of the railway companies and of the private oil-gas plants were met, there was no oil left for the manufacture of water gas. When the tax on gas oil was reduced from 10 marks to 3 marks, certain members of the gas industry believed the price would be low enough to suit their requirements. But although they knew that foreign oil would have to be used if water gas was made on a large scale, they took no steps to procure a supply. The chief reason why Roumanian oil was not on sale in Germany was the political disturbance in Russia, which caused Russian oils to disappear from the English markets. When Russia was once more pacified, the Roumanian oils would not be exported so largely to England, and more would be left for sale in Germany. In Dr. Spiegel's opinion, the proper course to pursue was to agitate for a removal of the upper limit of specific gravity; for a withdrawal of the regulation in question would benefit the gas industry and harm no member of the oil trade.

Herr Göhrum, of Stuttgart, objected to Dr. Schütte's statement that the high price of gas oil rendered it impossible to make water gas remuneratively. The assertion only applied to water gas carburetted by the hot process. On an average, 12 per cent. of blue water gas could be added to coal gas without producing any harmful effect upon its illuminating and calorific powers; while, moreover, the cold carburetting process with benzol remained unaffected.

In reply to several inquiries, Dr. Schütte explained that the new association for the purchase of gas oil on behalf of gas-works and engine proprietors was composed of the machinery works at Nuremberg and Augsburg, the Deutz Gas-Engine Factory, and the firm of Julius Pintsch. These firms had taken

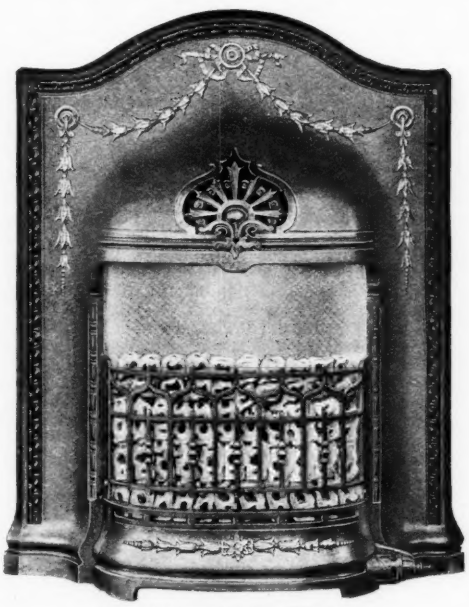
the matter up, not to drive other dealers from the field, but to enable their customers to purchase gas oil at the lowest possible rate. Gas oil was to be supplied at cost price to all persons who joined the Association and contributed to its capital. In reply to a speaker who was under the impression that his firm and others held quite sufficient oil to supply the German market, Dr. Bunte pointed out that the gas-works at Berlin by themselves could take the whole of the gas oil on the German markets—that is to say, all the crude petroleum and the brown coal oils, leaving none for the rest of the country.

After several other speakers had made a few brief remarks, a resolution was passed that the Council of the German Gas Association should submit the whole question of the supply of gas oil to gas-works in Germany to a fresh investigation, and should take such steps as might appear desirable to ensure a steady supply of carburetting oil at the lowest possible price.

THE "DIAMOND" GAS-FIRES.

In another part of the "JOURNAL" we notice the issue, by the Davis Gas-Stove Company, Limited, of an attractive booklet giving particulars of the new "Diamond" fires and other goods the Company have prepared for the coming season. To some of these special attention may be directed.

The stove illustrated below (No. 57 in the booklet) is an entirely new "Diamond" fire of "Adam" design; and, with its ornament of polished cast-brass festooning, we think it will be



The "Diamond" Fire, No. 57.

acknowledged that it has a handsome appearance. The fire space is 15 inches wide; and it has a powerful heating chamber. It is fitted with removable brick, a loose burner, a single row of fuel, and the "Davis" patent gas and air regulator. The gas supply may be taken in at either side. The Company claim that the general arrangements of the stove constitute it one of the most powerful heaters on the market. The No. 47 size—also of "Adam" design—is smaller than the one just described; the fire space being only 10 inches wide. It has no festooning; but in other respects it is similar. The Company consider that they have succeeded in producing a very high-class heating-stove at a price at which slot-fires are usually sold. No. 27 of the same series has been put upon the market to meet the wishes of those gas companies who desire to have a stove with a double row of fuel. It is of the same design as one with a single row which is in very great demand; but, of course, it has considerably higher heating capacity. The remainder of the "Diamond" series of fires have the now popular single-row fuel arrangement, as the Company's

The "Diamond" Special Slot Fire, No. 17.

contention is that as much heat as possible should be brought to the front of the stove. They have conducted extensive experiments in this direction, and have satisfied themselves that the single-row fire is the most efficient stove, with a very low gas consumption.

The stove No. 17 is a special slot fire, similar in design to one of larger size, but without a frieze, and having an 8-inch instead of a 10-inch fire space. It has all the features of the Company's high-priced stoves—such as the single row of fuel, gas and air adjuster, &c.—but is sold at a very low figure.

Another feature of the booklet under notice is the illustrated description of the "Diamond" gas-steam radiators, which have been designed and placed upon the market to meet the most exacting of modern requirements in the shape of heating apparatus. They are constructed of cast iron, and the loops are connected by means of left and right hand screw nipples at the top and bottom. They are mounted on cast-iron stands fitted with a bottom pan, which has a door for lighting and a flue for carrying away the products of combustion. The door and flue are reversible, so that each may be on the side of the radiator found to be most convenient. Every radiator is complete in itself, and may be readily removed from one position to another. An automatic valve is fitted to the gas supply, so that the consumption may be regulated when the desired temperature has been attained. "Diamond" radiators are odourless; and the Company claim that they are absolutely safe, and fully meet the requirements of the London County Council. They are supplied either with or without the flue outlet.

Other stoves to which attention may be called are the "Portland" reflector stove, which is also supplied as a fuel fire with a duplex burner; and the "Monsoon" condensing stove, of handsome design, for which a powerful duty, combined with economical gas consumption, is claimed. For those who require an artistic heating-stove, one of elegant design and high efficiency has been introduced, and will be found illustrated towards the end of the booklet. It is followed by the "Jap"—a condensing stove of a small, cheap, but useful type, specially adapted for use in offices, occasional rooms, small halls, &c.

TEST OF FERRO-CONCRETE RESERVOIR COVER.

The new covered service reservoir at Shedfield, forming part of the Soberton scheme of the Gosport Water Company, built entirely of ferro-concrete on the Mouchel-Hennebique system, has recently been tested under the direction of the designer, Mr. E. T. Hildred, Assoc.M.Inst.C.E., the Engineer to the Company. In order to enable our readers to appreciate the significance of the results furnished by the official tests, which were conducted on the 5th and 6th ult., we give a few brief notes relative to the main structural features of the work.

TABLE I.—TEST OF ROOF BAY.

Area of bay, 16 ft. 8 in. by 16 ft. = 266·66 sq. ft. Recording instruments A and B placed beneath the middle of the two intermediate secondary beams, dividing the bay into three panels.

Superload.		Deflection.			
Depth of Sand weighing 96 lbs. per Cubic Foot.	Weight per Square Foot of Roof Bay.	Decimals of an Inch.		Proportion of Span.	
		A	B	A	B
Inches.	Cwt.				
9	0·64	0·032	0·024	1/250	1/333
18	1·28	0·048	0·048	1/166	1/166
27	1·92	0·072	0·072	1/111	1/111
36	2·57	0·112	0·112	1/71	1/71
49	3·50	0·192	0·184	1/41	1/43
39	2·75	0·160	0·168	1/50	1/48

TABLE II.—TEST OF MAIN BEAM.

Beam 8 in. wide by 16 in. deep (exclusive of roof slab); span of beam, 16 feet; area of load, 16 ft. 8 in. by 16 ft. = 266·66 sq. ft. One recording instrument placed beneath the middle of the beam.

Superload.		Deflection.		
Depth of Sand weighing 96 lbs. per Cubic Foot.	Weight per Square Foot of Area Loaded.	Weight on the Beam.	Decimals of an Inch.	Proportion of Span.
Inches.	Cwt.	Tons.		
24	1·75	23·33	0·072	1/222
49	3·50	46·66	0·124	1/128
39	2·75	36·66	0·108	1/111

The reservoir comprises vertical walls 6 inches thick at the bottom and 4 inches thick at the top, and a continuous floor slab 7 inches thick, distributing the load at the rate of some 2 tons per square foot over the ground. The walls are stiffened by counterforts at frequent intervals along the exterior, and a partition wall divides the interior into two equal portions. The roof is supported

by the outer and partition walls, and by columns, 10 inches square, built up from the floor slab and spaced apart 16 ft. 8 in. longitudinally and 16 feet transversely. These columns support 8 in. by 16 in. main beams, and 7 in. by 12 in. secondary beams; each bay of 16 ft. 8 in. by 16 ft. being subdivided into three panels by two additional secondary beams. The thickness of the roof slab is 4 inches throughout.

For the official tests the Engineer selected one complete bay between four columns (the second from the north end and the third from the east side); and one main beam in the third row from the north end and the third span from the west side. The foregoing tables give particulars of the loading, and the deflections observed during and after the tests.

The tests were conducted under the personal direction of Mr. Hildred with the help of his assistant, Mr. S. R. Rafferty, in the presence of Mr. Dixon (representing Mr. L. G. Mouchel), and Mr. S. S. Wood (representing the Contractors, Messrs. R. H. B. Neal). Mr. Hildred states that the normal superload of 2·75 cwt. per square foot was left on during the whole night of the 5th of September until the morning of the 6th; and after an equal time had been allowed for recovery, the instruments beneath the roof bay showed the permanent deflection of 0·24 inch, which, being less than 1-40th of an inch, is negligible, and sufficiently demonstrates the almost perfect elasticity of the construction.

REGISTER OF PATENTS.

Fuel ("Coalite.")

PARKER, T., of Edgware Road, W.

No. 14,365; June 22, 1906.

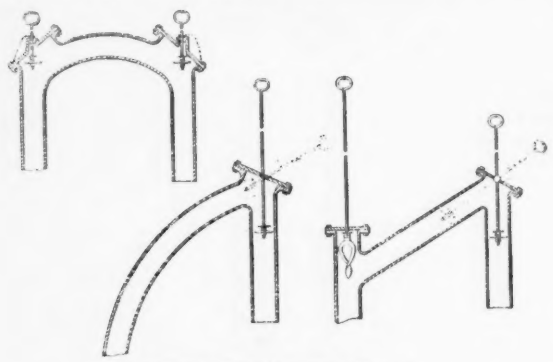
This patent specification—describing a method of manufacturing "an improved hard and smokeless fuel" "from bituminous coal by a process of partial destructive distillation"—was given in full in this "JOURNAL" for Oct. 8, p. 95. There are no drawings attached to the specification.

Ascension-Pipe Clearer.

CATLING, J. T., of Plaistow, Essex.

No. 22,638; Oct. 12, 1906.

To prevent stoppages in ascension-pipes, the patentee proposes to arrange for a rod in each ascension-pipe to pass out through an aperture or gland at the arch-pipe cap. The rod is provided with a scraping or cutting tool, so that "when moved up and down or rotated on its axis it will clear any deposit that may be formed."



Catling's Ascension-Pipe Clearer.

Various forms of ascension-pipes and dip-pipes fitted with apparatus are shown. In the third arrangement, the gland is mounted on a ball-socket, and is adapted to work in two directions.

Purifiers.

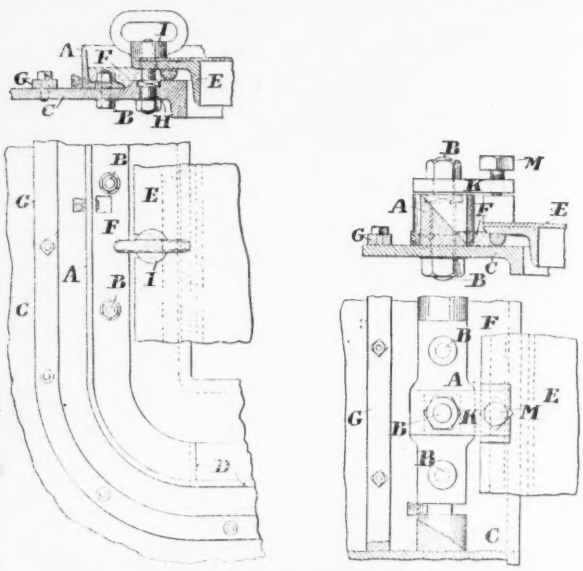
GREEN, H., of Preston.

No. 25,469; Nov. 12, 1906.

This invention relates to gas-purifiers with covers fastened with a compressible gasket. Hitherto in joints of the character referred to, the patentee remarks, no provision has been made for ascertaining when they attain the required degree of tightness. Hence it has been essential to subject the gasket to greater pressure than is absolutely necessary, in order to make certain that the joint is effective. And since india-rubber is the material most frequently adopted in the formation of the gasket, "the excessive compression of the material necessary, in the absence of any means for ascertaining the absolute tightness of the joint, soon causes it to lose its inherent qualities and shortens its life; it also further tends to loosen or detach the gasket from the surface to which it is attached." The object, therefore, of the present invention is to avoid these disadvantages, by providing a temporary water-seal test at the time of making the joint, so that the gasket need not be compressed more than is necessary to render the joint effective.

A ledge, wall, fin, or the like is provided around the edge of the opening in the top of the purifier, and at a suitable distance from the cover when in position; so as to form, with the interposed india-rubber packing ring, a chamber into which water may be introduced to form a seal and afford an indication as to whether or not the joint is tight.

Two ways of carrying out the invention are shown. In the first (in the case of existing purifiers), the ledge may be constituted of removable lengths A of ordinary angle iron, bolted at B or otherwise secured in a liquid-tight manner to each side of the purifier top C, and having co-acting ends of adjacent lengths scarfed, as at D, or otherwise jointed together to form, with the purifier top and the packing ring or gasket, a



Green's Purifier Joints.

channel F to hold the liquid to form the partial seal. To constitute a channel for conducting away the liquid of the seal, lengths G of bar iron may be similarly secured to the purifier top C at a short distance outside the ledge A; one or more passages being provided in the latter in communication with the channel and controlled by plugs of wood or metal, so that the water can be discharged by their removal—although it might, of course, in some cases be allowed to dissipate over the purifier top.

Another form the ledge A may take when secured to the upper side of the purifier top, is that of a right-angled triangle, the right angle being remote from the edge of the purifier opening and the base being sufficiently broad to form, with the purifier top C, a water-tight joint.

The cover may be secured in any convenient way. For instance, in the first form shown, bolts H are arranged around the edge of the purifier top so as to engage slots in the cover; handled nuts I being used with such bolts to produce the necessary pressure upon the gasket, which may conveniently be more or less semicircular in cross section, as shown. In the second case, there may be employed a plurality of devices each comprising a holding-down bar K, carrying at one end a tightening or set screw M adapted to engage or bear upon a lug or block on the purifier cover, or on the purifier cover direct, and provided at the other end with an eye or hole adapted to work loosely on a bolt B so that, when the tightening or set screw M is slackened, the bar can be swung clear of the cover. The bolt employed for this holding-down bar may conveniently be formed with a collar or shoulder at an intermediate part of its length, so that, by passing it through a boss formed on the corresponding ledge section A, it may serve the additional purpose of securing the ledge section to the purifier top.

Generating Combustible Gas.

THWAITE, B. H., of Great George Street, S.W.

No. 26,819; Nov. 26, 1906.

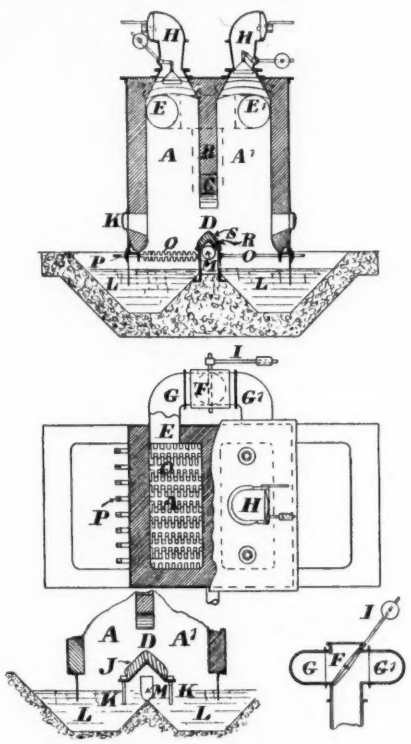
This invention relates to a combustible gas generating process, characterized by the fact that in a reversible process, and its associated double generating chamber or vessel, the volatile hydrocarbon gases evolved from the fresh coal fed into one of the two generating chambers are compelled to flow downwards through the incandescent fuel in the generator, escaping into the adjoining and associated vessel, at a point one-third the height of the column of fuel. These volatile gases force their way through the column of incandescent fuel to the escape outlet above the fuel; and in their flow, they become intimately mixed with the carbonic oxide generated by the flow of air through the depth of fuel on the grates of both vessels—such depth of fuel being adequate to produce combustible gases. The fresh fuel is alternately fed into one vessel and then into the other at intervals of time depending upon the character of the fuel; the direction of the flow of the gases being effected by a reversal outlet valve, common to both generating vessels.

The *raison d'être* of the invention is embodied in former inventi on for which patents were granted—Nos. 13,385 and 18,445 of 1894.

The illustration (p. 265) shows a vertical section of one form of apparatus required; a half plan and half section; a section of an alternative arrangement of the lower or grate part of the gas generating apparatus; and a detail in section of the reversal valve, which is an essential element of the apparatus.

The generating apparatus is divided into two chambers A A^1 by the central partition wall B, which is carried by an arch C that spans the generator at about one-third its height. The space D beneath forms the fuel connection that permits the gas to flow from one chamber into the other, and *vice versâ*. Outlet openings E E^1 are provided over the fuel level in each chamber. These two outlets lead into a common or central butterfly reversal valve F, the connection from the outlets being made by fire-brick lined connections G G^1. The valve directs the escape flow of the gas from the apparatus, alternately from one chamber

and then from the other—the alternations of direction coinciding with the charging operations. For instance, when fuel is fed by the hopper H into one chamber A, the reversal valve F is thrown over by the lever I, closing off the outlet E of escape from the chamber. The fuel is charged every 15 to 30 minutes, in alternately one and then the other of the chambers A A^1.



Thwaite's Generator.

The fresh fuel charged into the chamber is subjected to the heat of the hot fuel in the chamber, and the volatile gases are immediately given off and force their way (or in suction type of generator are also drawn downwards) through the column of incandescent fuel; being purified or scrubbed in their progress, first downwards and then upwards—the hydrocarbons being, as far as practicable, fixed in or during their passage through the interstices of the more or less incandescent fuel.

These volatile gases at the lowest point of descent pass under the soffit of the arch C, mixing with the carbonic oxide and other gases produced by the combustion of the fuel on the hearth of the generator, and passing along with these gases in an upward direction through the fuel in the upward flow chamber.

Referring to the alternative method of grate construction, there is hung from a central fire-bar bridge J, vertical bars K suspended on each side as shown, and with their lower ends dipping into the water of a hydraulic bath L. The air, under pressure, is introduced into the centre of this bridge by the inlet opening M. The air forces down the water in the hydraulic bath on the inside of the generator, exposing a greater part of the vertical fire-bars K.

Again referring to the first arrangement, the grate-bars O are of the rotating or tilting type, as shown, so designed as with their projections to interlace. The front part of the bars P, which partly projects outside the apparatus, is connected to the herring-bone shaped bars by the insertion of the former into the latter; the projecting part being square in section, so that the rotation of the projecting part by means of a key rotates the herring-bone shaped part. The withdrawal of the projecting part allows the herring-bone part of the fire-bar to fall into the water of the bath. The projecting part is carried by the flange-shaped girder supporting the wall of the generator; while the other, or inside, end is supported by a central bridge casting having an inverted cone shaped top R carrying the fire-brick saddle S.

The central bridge serves to introduce the air pressure uniformly all along the underside of the grate O; perforations, spaces, or holes in the vertical sides of the central bridge permitting the air to enter the space under the grate. If the grate is of the vertical type, the vertical bars are spaced nearer together at the ends than in the middle position.

Automatic Gas Lighting and Extinguishing Apparatus.

Bonniksen, B., of Coventry, and Berridge, T., of Leamington.
No. 12,619; May 31, 1907.

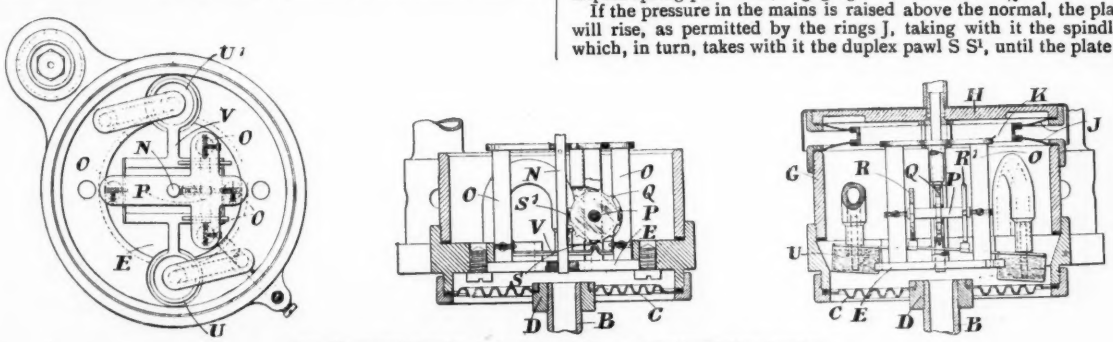
This invention, for the chief part, is an improvement on the apparatus described in patent No. 4377 of 1906—a diaphragm acted upon by variations of pressure in the gas-mains to actuate certain mechanism. The patentees say that a diaphragm is liable to operate unsatisfactorily, inasmuch as the tendency to lift decreases as the diaphragm rises; so that the diaphragm is liable to start moving under very slight variations of pressure, but a relatively great increase of pressure is necessary to make it rise to its full height. One object of the present invention is to overcome this difficulty by providing one end of the gas-chamber with a movable cover plate, connected to the stationary gas-chamber by flexible rings attached to a floating ring and to the movable and stationary parts, "somewhat after the manner of the bellows devices which have previously been proposed." Another object is to simplify the mechanism employed; while a still further object is to provide an anti-vibratory support for the mechanism, whereby incandescent mantles may be used.

The illustrations are a plan with the movable cover plate and flexible rings removed, and two sections at right angles to each other—the operating mechanism being shown in elevation.

The apparatus is carried upon the service-pipe B; but if some anti-vibratory device is to be used, a corrugated metal plate C is attached both to the base-plate and to a ring D screwed upon the service-pipe. The centre of the base-plate is cut away to receive a platform E, which carries the mechanism. Screwed into the base-plate is a short length of tube G (which forms the walls of the gas-chamber), and the top plate H is not attached directly and rigidly to this tubular part, but is arranged so that it can move in relation thereto. For this purpose, a pair or more of flexible rings J (of sheet canvas and rubber) are attached to a floating ring K and to the movable plate H and tubular portion G, as shown. The ring K is flanged, and the edges of the rings J are gripped between the flanges, making a gas-tight joint.

Connected to the movable plate H is the actuating spindle N, which is a sliding fit in the platform E and is adapted to move in relation thereto, with the cover-plate H. It also is a sliding fit in a plate supported by pillars O from the platform E. These pillars are four in number, arranged as a cross, and the top plate is cruciform in shape. Carried in bearings between two of the pillars O is a spindle P carrying a driving rachet-wheel Q and cams R R^1. The spindle N carries a duplex spring pawl S S^1, engaging the rachet-wheel Q.

If the pressure in the mains is raised above the normal, the plate H will rise, as permitted by the rings J, taking with it the spindle N, which, in turn, takes with it the duplex pawl S S^1, until the plate is at



Bonniksen and Berridge's Lamp Lighting and Extinguishing Device.

its maximum height. Before then the pawl S^1 engages one of the teeth of the ratchet-wheel Q, rotating it in a clockwise direction—the pawl S gradually approaching the ratchet-wheel as the plate H rises. By the time the ratchet-wheel has moved through an angle corresponding to the distance between a pair of adjacent teeth, the pawl S engages the ratchet-wheel and prevents any further rotary movement. While the plate H is falling, a click prevents rotation of the ratchet-wheel in the opposite direction.

In the earlier construction, mercury cups carried by a rocker were employed to cover and uncover the gas supply to the burner and to the bye-pass. These cups U U^1 are mounted upon a rectangular frame V, which takes the form of a rocker, pivoted to two of the pedestals O, and formed with a pair of projections which engage the cams R R^1.

The cams shown are for a three-cycle apparatus—that is to say, for one increase of pressure all the lamps in a town can be lit; for the next increase, some of the lamps can be put out; while at the next increase the remainder are put out, but those previously extinguished are left unaffected. In the present construction it will require first one movement of the driving ratchet-wheel Q to operate the rocker, and then two movements followed by one movement and two movements and so forth. It will be seen, therefore, that it depends which cam—R or R^1—is upon which side as to whether any particular lamp will be extinguished early or late. It is possible, therefore, by interchanging the cams, to arrange that a lamp shall be extinguished late that was previously extinguished early, and *vice versa*. For this purpose; the mechanism and the plate E are adapted to be rotated half-a-revolution in relation to the base-plate which carries the U-shaped pipes. For this purpose, the platform is formed with a pair of notches diametrically opposite to one another; and a projection carried by the base-plate is adapted to engage one of these, to determine its position.

Non-Freezing Device for Gasholders.

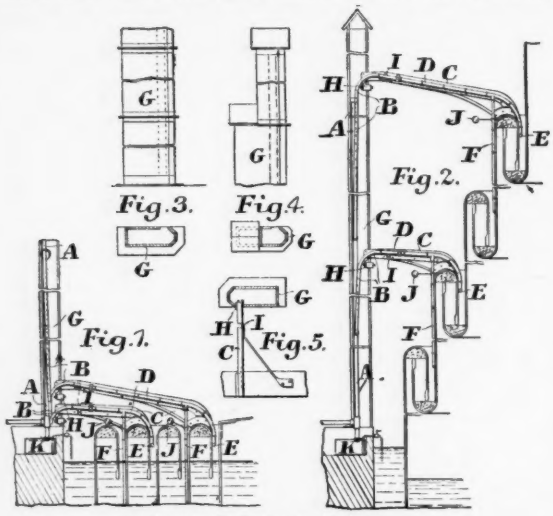
ROOK, G. E., of Hornsey Road, N.

No. 10,523 ; May 6, 1907.

This invention relates to improvements in anti-freezing or non-freezing devices for gasholders of the kind in which steam is conducted through pipes into the water-cups between the different sections of the holder.

The inventor employs a vertical steam-pipe, to which flexible pipes are connected at any desired positions—being carried from the vertical pipe to the holder by brackets or stays, and attached to a preferably stiff or non-flexible pipe on them ; the ends of the stiff pipes terminating in or at the cups of the holders. When the holders move up or down, they carry the brackets with them, and extend or fold the flexible pipe according to their movements. To meet the case of the holder twisting a little in rising, the brackets are preferably made with a joint or hinge in them, to allow them to bend. If a second pipe is conducted from the pipe on the bracket, it may be controlled by a valve having a weighted arm, which, when the sections of the holder descend, strikes the section below it in such a way as to operate the valve and shut off or open the steam as required.

Fig. 1 shows the invention applied to a holder at its lowest position. Fig. 2 is a view of the holder extended. Figs. 3 and 4 are views of portions of the wind-shield or slot-tower employed. Fig. 5 is a sectional view of the slot-tower, and shows a bracket fixed to the holder.



Rook's Gasholder Anti-Freezer.

The pipe A leads from any convenient source of steam ; and to it the flexible branch pipes B are attached. Each branch pipe is fixed to the end of a bracket C and connected to a pipe D, terminating at E in one of the water-cups ; while the branch pipe F terminates in another cup. G is the wind-shield with a slot in which rollers H, on the brackets C, guide them in their up-and-down movements. The brackets are made in two parts hinged together at I for the purpose of allowing some side movement necessary in rough weather, or in case the holder does not rise accurately. The steam is controlled by valves having weighted arms J, which, when the sections of the holder descend, strike a section below them in such a way as to operate the valves and shut off the steam. K is a draining tank to receive any condensation in the tube ; and the tank may be syphoned to the water round the holder.

Immersion Baths for Incandescent Mantles.

THOMPSON, W. P. ; a communication from R. EISENMANN, of Berlin.

No. 15,536; July 5, 1907.

As is well known, an immersion bath, consisting substantially of a solution of pyroxylin or gun cotton, to which, in addition to other substances, castor oil and camphor are added for the purpose of avoiding shrinkage in the subsequent drying, is employed for hardening incandescent mantles, so as to allow of their being better carried or conveyed. But the patentee proposes to replace the camphor by compound ethers (esters) or nitro compounds of the aromatic substances, or aldehydes or substituted amides or ketones or mixtures of these substances—a large number of which he particularizes.

APPLICATIONS FOR LETTERS PATENT.

21,993.—MOORE, W. G., "Regenerative gas furnaces." Oct. 5.
21,995.—RUUD, E., "Bunsen burners." Oct. 5.
21,996.—WHITFIELD, C., "Gas-pressure controller." Oct. 5.
22,122.—LEDENT, M., "Heating apparatus with gaseous fuel." Oct. 7.
22,138.—ELLIOTT, J. R., "Intermittently discharging a desired volume of water from reservoirs." Oct. 8.
22,155.—WOLFENDEN, E., "Mantle holder." Oct. 8.
22,274.—JOHNSTON, A. A., "Manufacture of coal gas." Oct. 9.
22,293.—WIRTZ, L., "Calcination of coal." Oct. 9.
22,298.—GUTENSOHN, A., "Treatment of tar." Oct. 9.
22,403.—SALOMONSOHN, G., "Catalytic lighting appliances." Oct. 10.
22,411.—WALKER, G. A., "Gas-fittings." Oct. 10.
22,449.—ULRICH, J , "Regulating the rate of gas production to the consumption." Oct. 11.
22,453.—ROBINSON, T. & R., BOYD, T. B., and LUNNEY, G., "Reducing valves." Oct. 11.
22,485.—SIMPSON, S., "Gas-meters." Oct. 11.
22,519.—WILSON, H., "Gas-fires." Oct. 12.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

The Gas-Heating Business Field.

SIR,—If only a few of those interested in this subject have taken part in the correspondence you have invited, it should not be assumed that there is general indifference to it. Personally, I have never been able to join in general condemnation of the "old days," of which it has been said that gas officials were autocratic, and by their actions, if not in words, were in the habit of telling people "they could either take it or leave it." My experience now extends over a quarter-of-a-century ; and at the very outset I was taught that courtesy to, and consideration for, a consumer were the essential elements to success. No narrow interpretation was given to this teaching ; for it meant that anything and everything that was likely to be useful to consumers should be brought to their notice, and that they should be made to feel that the proprietors of the gas undertaking were anxious to be their servants, and to obtain their confidence.

In putting these principles into practice, it is needless to say that the measure of success has not always been the same. But success there has been all the time. The "heating field" has not been neglected ; but it must be admitted that it has not met with the response which has characterized the "cooking field." Many causes have been assigned for this general experience ; and probably each one has been a contributing factor. The one to which most attention is usually given is that of the price of gas ; and the demand for differential prices invariably follows. The question naturally arises—but is seldom asked—"Are gas companies acting within their statutory powers in making differential charges?" It is now customary to have a discount clause in Private Acts of Parliament. This is, however, usually limited to 20 per cent. ; and where discounts are allowed on the basis of consumption for all purposes, the margin left does not permit of any marked reduction in the price for heating purposes any more than for power consumption, even if it is permissible to apply this discount to special purposes, which is doubtful. If it is possible to embody provisions for removing any disabilities under which gas companies are working in this respect in the contemplated new Gas-Works Clauses Act, it will surely be done, and thus place us on a more equitable basis of competition with our rivals.

But price of gas is not the only factor which impedes progress in the "heating field." Initial cost is probably as great a stumbling-block. Some years ago, the Company with whom I am associated adopted a scheme for hiring out gas-fires. The rentals were very reasonable ; but the cost of fixing had to be borne by the consumer. The scheme went fairly well for a time, but latterly the rate of progress has declined ; and having the impression that the cost of fixing was to some extent the cause of this decline, it has been decided to adopt a scheme of hire-purchase—the payments being extended over a period of eight years, and the cost of fixing being covered by the rental. Under this scheme many gas-fires suitable for bedrooms and small sitting rooms can be obtained at rentals of less than 1s. per quarter, and some as low as 6d. As the scheme has only just been adopted, it is impossible to say how far it will meet the requirements of the public ; but it removes the barrier of initial cost.

If we are not permitted to make special reductions in the price of gas to any appreciable extent, there is no legal obstacle to giving concessions in the supplying of the apparatus ; and by doing this we shall doubtless increase the consumption of gas for heating purposes.

Hexham, Oct. 17, 1907. HERBERT LEES.

The De Brouwer and the Ludbrook-Cole Machines.

SIR,—I have read with interest a letter in your issue of Oct. 1, under the above heading, with reference to a similarity in the machines—one patented by M. De Brouwer, No. 14,089 of 1903, and one patented by Mr. W. L. Cole and myself, No. 20,325 of 1906.

Parts of machinery may be somewhat alike without infringement ; and I may add that the similarity in the parts of these machines was noticed by the Comptroller of Patents, and reference to them is duly made in our patent as granted. But, as a matter of fact, the method of winding the chain on the drum is on a totally different principle. I may add that this machine is specially designed for a retort-house with very limited space and with inclined retorts.

I thank M. De Brouwer for the good opinion he formed of my discharging machine, patent No. 14,980 of 1905 (not the one above-mentioned), which he saw on the first day it was put to work, about 18 months ago, working in conjunction with his De Brouwer charging-machine ; and I have great satisfaction in telling him that his good opinion has been fully justified, as the machine has been in constant work ever since, pushing out 28 twenty-foot retorts each hour, in 23 minutes, and giving the greatest satisfaction.

Oct. 14, 1907. S. W. LUDBROOK.

The "Coalite" Specification.

SIR,—I have read the "Editorial Note" in your issue of the 8th inst., and I find on looking through the specification that there is no suggestion made in it of originality in the use of vertical retorts nor in the destructive distillation at 800° Fahr., in itself, nor yet in the general use of steam for quenching the residuum. Your criticism of the "Coalite" specification appears to be based upon the supposition that some claim to originality was made to these general features ; but this supposition, I think you will agree with me on reference to the specification, is erroneous.

I observe that you give the specification of the American patent. If an American patent as well as an English patent has been granted on "Coalite," is this not pretty conclusive as to the novelty of the process?

Hampstead, Oct. 14, 1907. RICHARD DAVIES.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE—KING'S BENCH DIVISION.

Monday, Oct. 14.

(*Before Justices* PHILLIMORE *and* WALTON.)

Croydon Rural District Council v. Sutton District Water Company (Ewart third party)—Damage Caused by Extraordinary Traffic.

This was an appeal by the defendant Company from the decision of Judge Russell, sitting at the Croydon County Court; the question raised being whether or not the Company were entitled to an indemnity from their Contractor, Mr. Ewart (who undertook to construct a reservoir and accessories), in respect of liability for extraordinary traffic. The District Council sued the Company, who brought in the Contractor as third party; and it was agreed that, if an indemnity had to be given, the amount was £37 10s. The contract in question was to construct a reservoir and supply all necessary materials at How Green, near Chipstead; and Mr. Ewart engaged third parties to deliver the materials on the site. The materials were brought in trucks drawn by traction-engines, which caused damage to the road. The contract provided that the Contractor should be responsible for all injury resulting from the execution of the works, whether or not these were carried out skilfully; and the question was whether damage caused by extraordinary traffic came within this provision.

Mr. DANCKWERTS, K.C., and Mr. MACKENZIE appeared for the appellants; while Mr. BANKES, K.C., and Mr. HENRY represented the Contractor.

Their LORDSHIPS held that the damage in respect of which the Company had had to pay compensation was done to "property" within the meaning of section 23 of the Locomotives and Highways Act, and resulted from "the execution of the works." They had no doubt that the parties intended by the words "execution of the works" not only execution on the spot, but the necessary hauling to bring the materials to the spot—in fact, everything the Contractor had to do which would result in producing the reservoir contracted for.

The appeal was allowed, with costs; but as it was stated that this was a test case, and might bind other actions, their Lordships gave leave to appeal.

The Sale of the Beverley Water-Works.

This matter came before Mr. Justice Parker, in the Companies' Winding-Up Court, last Tuesday. Mr. Adams said it was an application for directions as to how the Liquidator, for whom he appeared, was to distribute the surplus proceeds of the sale of the undertaking of the Beverley Water Company—a statutory Company incorporated by Private Act—who had, under the powers of the Public Health Act, sold their concern to the Corporation. A question had arisen owing to the purchase price (£20,850) being insufficient to satisfy in full the holders of the preference stock and the ordinary shares. The Company had issued £4500 of 4½ per cent. debenture stock, which, under the terms of the purchase agreement, had to be paid in full, together with a premium of 10 per cent. for accepting payment before it was due. The Company also issued £3000 of 5 per cent. preference stock and 1800 £10 ordinary shares. After providing for the debenture stock, the Liquidator calculated that he would have £16,400 available for distribution between the preference and the ordinary shareholders. The amount due to them was £21,000; so that there would have to be an abatement somewhere. The question at issue was whether the holders of preference stock were entitled to be paid in full, or whether their stock must be abated along with the ordinary shares. This was a point to be argued by Counsel for the two classes of holders. After hearing the arguments, his Lordship held that, as there was nothing in the Special Act giving the preference shareholders priority in any distribution of capital, there must be equality in the distribution of the assets; and he made a declaration accordingly.

Responsibility for Leakage from Street Hydrants.

At the Shoreditch County Court, on Monday last week, before his Honour Judge Smyly, K.C., and a Jury, Mrs. Lily Mynott, a waitress, of Canrobert Street, Old Bethnal Green Road, sued the Mayor, Aldermen, and burgesses of the borough of Bethnal Green, to recover £50 damages for injuries received through slipping on some ice formed by the water from one of the Borough Council's stand-pipes freezing on the pavement. The husband also claimed compensation for the amount he had had to pay to a person to look after his home during his wife's illness. Mrs. Mynott failed to sustain her claim; and her husband proceeded with his case. Evidence was given by a constable and another witness to the effect that the ice was spread over the pavement for a space of 5 feet. Mr. Abinger, who appeared for the defendants, submitted that he had no case to answer, as the hydrant was not vested in the Borough Council, as they were bound to carry out the scavenging, and any default by omission could only be proceeded upon by prosecution. Snow and ice came under the term "refuse." It was only if the hydrant was defective that any action would lie; and it had been held that no pipe could be made without a leak of some sort. His Honour said he was doubtful if the hydrant was vested in the Council, except as surveyors of the highways. Mr. Lincoln Reed, who appeared for the plaintiffs, said that under the Metropolis Management Act of 1875 these stand-pipes were vested in the local authority, and not as the surveyors of the highways. Mr. Abinger called a number of witnesses, who suggested that ice could not form on the pavement, as it sloped upwards to the houses, and the hydrant was on the kerb. Mr. James Godfrey, the Surveyor of Water-Mains for the Council, said it was possible, by careful handling, to close the hydrants so that they did not leak; but nevertheless they would "weep." The Jury found for the plaintiff for £2 10s. damages, and, in answer to his Honour, said their finding was on negligence in turning off the water.

MISCELLANEOUS NEWS.

IMPERIAL CONTINENTAL GAS ASSOCIATION.

Issue of the Balance-Sheet.

Accompanying the notice issued by the Secretary of the Imperial Continental Gas Association (Mr. Robert W. Wilson) for the half-yearly meeting which is to be held on the 5th prox. is the balance-sheet on the 30th of June last. As this is the first time the accounts of the Association have been furnished to the proprietors, we give the principal items.

The capital stock stands at £4,940,000; there is £473,600 3½ per cent. debenture stock; and the premiums on the stocks figure for £327,345. Other items on the same side of the balance-sheet include the following: Interest on debenture stock, £6909; dividends unpaid, £3374; sundry creditors, £521,669; dividend equalization account, £327,500, pension reserve £70,000. On the opposite side, works and mains (less amortization) stand for £3,533,490; land is put down at £488,662—making together £4,022,152. Stocks are valued at £559,456; there is cash at the stations, at the bank, and in the London office amounting to £114,668; and sundry debtors figure for £499,004. The Association have investments in English and Indian securities entered for £275,628; and their investments and loans abroad (less depreciation and amortization) stand for £1,115,098. Loans on the security of bills (£156,500) and freehold property in London and abroad (£181,326) make up a total of £6,923,834. In addition, the Association possess £400,000 of 2½ per cent. Consols invested as a reserve fund.

The balance brought forward was £16,040; and the profit for the half-year was £237,395. As already announced in the "JOURNAL," the Directors will recommend the declaration of a dividend, free of income-tax, at the rate of 4 per cent. for the past six months.

DANISH GAS COMPANY.

Annual Report and Accounts.

At the Annual General Meeting of this Company to-day, the Directors will report that the net revenue for the year ended the 30th of June last was £67,164; being an increase of £2083 on that for the preceding twelve months. Adding the amount brought forward, the total credit to the profit and loss account is £100,069. Deducting from this sum the interest on debenture capital, loss on exchange, and the usual amounts set aside for reserve and depreciation, there remains £77,879 available for dividend.

An interim dividend at the rate of 2½ per cent. on the old preference shares and 4 per cent. on the ordinary shares has already been paid; and the Directors now recommend that there should be declared a dividend of 2½ per cent. on the preference (including the £50,000 of new shares ranking for dividend from Jan. 1 last), and 5 per cent. on the ordinary shares, together with a bonus of 1 per cent. upon the ordinary shares. These dividends and bonus will amount together to £41,250, and leave a balance of £36,629 to be carried forward. The net amount charged to capital account during the year for additional buildings, apparatus, mains, services, and meters was £50,279.

The consumption of gas during the past year showed an increase of 6·88 per cent. over that of the preceding twelve months. The negotiations with the Flensburg authorities with reference to the plans for the new works were continued, and final arrangements have been made for the works to be proceeded with. The concession for the supply of gas and water to the inhabitants of a district at the south of Elsinore has been arranged with the Tikjob authorities; and the laying of the mains, &c., will shortly be commenced. The gas will be supplied from the Company's works at Elsinore, and land for the water-works, suitably situated in the Tikjob district, has been purchased. A new contract has been arranged with the town of Assens, whereby the present concession is extended to Jan. 1, 1921, and the Company make certain reductions in the price charged for gas, &c.

Accompanying the Directors' report is that of the Engineer (Mr. A. W. Edwards), in which a steady increase in the Company's business is recorded. The total consumption of gas last year was 1,018,037,000 cubic feet; being an increase of 65,519,000 cubic feet, or 6·88 per cent., compared with the twelve months ending June 30, 1906. The new retort-house at Odense, mentioned in his previous report, has been completed and taken into use; and the working results of the house are quite satisfactory. The empty arches in the retort-house at Aalborg have all been built up, and the works will have an ample reserve of retorts for the winter. As the storage capacity is now becoming too small, it will be necessary next summer to erect an additional gasholder, for which drawings are being prepared. The increase in the consumption of gas in Viborg is still large, though the town has started electricity works of its own. It will be necessary next summer to extend the retort-house, as the productive capacity will this winter reach its maximum. The increase in the consumption of gas at Assens—the Company's smallest station—is satisfactory. The Strandvel district is developing quickly; and though the Tramway Company have commenced to supply electricity for lighting and power, the increase in the consumption of gas is considerable. The new retort-house and coal-store at Frederiksberg have been taken into use, as well as the new sulphate apparatus and the boiler. The extension of the condensing and washing plant and of the purifiers is being considered. The demand for coke and tar continues good. Mr. Edwards adds that all the necessary alterations and repairs at the different stations have been carried out or are in progress, and all the stations will be in good working order for the ensuing winter.

PUBLIC LIGHTING OF EDINBURGH.

Annual Report of the Inspector.

In the course of his report to the Edinburgh City Council for the year ending May 15 last, Mr. George A. D. Mackay, the Inspector of Cleaning and Lighting, remarks that for some time past earnest and continuous efforts have been made to effect improvements in the gas lighting of the city; and in this respect the municipal year 1906-7 has proved a record one. The previous year, some 5000 of the old-fashioned street-lamps had been converted into incandescents; and the year now under review has witnessed the disappearance of all the flat-flame burners, for which incandescents have been substituted. The superior illumination of the incandescent burner over that which it has displaced is so great that, as a whole, the result marks the completion of a lighting transformation which may be said to constitute an epoch in the lighting of the city. Edinburgh with its electric lighting of its main thoroughfares and car-routes, its incandescent illumination of its other streets, and of its courts and closes, and its stair-lights burning from sunset to sunrise, has now reached a stage of effective lighting which commands the approbation of the citizens and elicits commendation from visitors and other municipalities. At May 15 last, the streets, &c., of the city were lighted by 9940 incandescent gas-lamps and 1175 electric arc lamps; and the common stairs by 12,123 gas-jets and 70 electric lights. In the previous year the number of gas-lamps was 10,118, which has been reduced by 178. The decrease is accounted for by an increase of 123 in the number of arc lamps, each one of which displaces a fraction over three gas-lamps. The additional electric lamps have been erected in quarters of the city where the movement of population, and the extent of traffic, called for more light. The number of stair-jets at May 15 of last year, which stood at 11,802, has risen to 12,123; being an increase of 321. The increase, to some extent, is due to the erection of new buildings, but mainly to the demand for improved lighting, which has been stimulated by the better lighting of the streets. The 9940 incandescent gas-lamps have a varied consumption. There are 1080 2-feet burners, 5352 2¼-feet burners, and 3508 3-feet burners.

The improved lighting in the streets has created a desire to have the stairs lighted with the incandescent burner. By way of experiment, this burner has been introduced into a few stairs. The lights, however, being unprotected and easily injured, there is, at least meantime, little progress in this direction. The number of stairs incandescently lighted is 13, with 36 jets. For some quarters of the city, where better-class houses are being erected and electric mains are available, there is a disposition to have the stairs lighted with electricity. Progress in this direction is so far not considerable; but there are indications of growth.

The street-lighting expenditure for the year under review was:—

For street gas lighting, including cost of gas, with due proportion of lamplighters' wages and incidental expenses	£21,434	2	1
For electric lighting, including incidental expenses	10,272	10	8
For stair lighting, including gas, proportion of wages, and other expenses	11,893	7	3
Total	£43,600	0	0

The expenditure for 1906-7, as compared with that of the previous year, shows a decrease of £2100 19s. 10d. Considering that the expense of converting 5000 lamps with flat-flame burners into incandescents during the year was incurred, this, Mr. Mackay says, requires some explanation, and it is found in the arrangement made by the Council that the cost of this year's conversions should be spread over three years, whereas the cost of previous lighting improvements was charged to current account. The cost of this year's conversions was £10,725, a third of which (£3575) was charged to the year.

The municipal reputation of Edinburgh, Mr. Mackay remarks, has been greatly increased by its management of the electric light, the success of which has been quite phenomenal. In 1895-6, the number of arc lamps in use was 245, and their annual cost was £20 each. In 1906-7 there were 1175, the annual cost of which per lamp was £9. These 1175 arc lamps displaced 3718 gas-lamps, representing 4095 jets. In 1891-2, the charge for gas to the Corporation was 3s. 6d. per 1000 cubic feet, and to the public 1s. more. At the beginning of the century the public rate was 2s. 5d., and the private one 3s. In the three succeeding years, there was a rise of 3d. in the public rate; but it was brought back to the old figure in 1903-4, and has been continued —the gas supplied to the incandescent burners being priced at 2s. per 1000 feet. The private rates were 3s. 4d. and 3s. in 1902-3, and 3s. and 2s. 9d. in 1903-4; and the latter figure has been charged since.

The number of gas-lamps in use in the year 1890-1 was 9586; in the year reported upon, it was 9940. Mr. Mackay says the waste of lighting plant is very considerable, arising not so much from ordinary wear and tear, as through carts and other vehicles coming into collision with the lamps, and also not infrequently through malicious mischief on the part of idle boys and night marauders. Breakages from these causes are very frequent; the replacing of the damaged or broken tops, globes, and pillars representing a considerable annual expenditure.

The expenditure on the public lighting in the past year was £43,600, and the revenue was £5 5s. The net expenditure was therefore £43,594. The population being 345,747, the cost per head works out to 2s. 6¼d., and the cost per pound on the assessable rental is 3¾d.

Warrington Water-Works Arbitration.—An arbitration was opened on Monday of last week at the Surveyors' Institution between Mr. George Lawson and the Warrington Corporation, in regard to a contract entered into by Mr. Lawson in connection with the Corporation water-works. Mr. George H. Hill was the sole Arbitrator; while the Counsel appearing were: Mr. Radcliffe, K.C., and Mr. G. A. Scott for Mr. Lawson, and Mr. A. A. Hudson and Mr. Arnold Inman for the Corporation. The Arbitrator decided that it was not desirable the Press should be admitted, after Mr. Radcliffe had expressed the wish of his side that the proceedings should be conducted in private.

LIVERPOOL PUBLIC LIGHTING.

Last Year's Work.—Testing Consumers' Fittings.

The various Committees of the Liverpool Corporation have been holding their final meetings for the current municipal year; and at these, in reply to votes of thanks for their services, the Chairmen usually give an outline of what has been done in their special departments during the twelve months.

At the meeting of the Lighting Sub-Committee last Thursday, Mr. W. W. Walter, the Chairman, was heartily thanked for what he had done; and, in reply, he furnished some particulars of the work that had been carried out by the department. He said the lighting of streets, passages, &c., had been considerably curtailed during the past year, owing to the decision of the Committee to make abutting property-owners bear the expense of providing street lighting in unadopted streets. Objection was at first raised to this by the owners; but when it was understood that the Committee were determined to adhere to their decision, orders began to be placed with the Committee for the execution of the work, so that at present there was more work in hand than could be conveniently dealt with. During the year, orders were received for 46 street lamps and 30 passage lamps to be erected at the expense of the owners at a cost of £237. Not only had this new revenue been derived, but the usual expenditure of between £800 and £900 per annum on new lamps had been saved; so that by the decision of the Committee in this connection a total saving of over £1100 had been effected. In adopted streets, passages, &c., 79 lamps had been fixed, and 107 removed to new positions. The work of testing consumers' gas pipes and fittings for the nominal sum of 2s. 6d. had been greatly appreciated by the public; 224 tests having been made. Of these gas-pipes, only 25 were found to be sound; and so serious were some of the escapes that the matter had been referred to the Health Committee for their observations. The revenue derived from this source since the date of the institution of the testing in April last amounted to £28. In automatic lighting, &c., of street-lamps, the Committee had been experimenting with a small installation of automatic controllers, which had been most satisfactory. The daily testing of the gas at the central office indicated an average for the year of 20·77 candles; while tests on the district averaged out at 20·83 candles, against the parliamentary standard of 20 candles. There had been 10,754 gas-meters tested; this being a small increase on the previous year, which was a record one. Of these, 507, or 4·7 per cent., were rejected. The department tested 2261 electricity meters, of which 844, or 37 per cent., were rejected. The whole of the gas-fitting work in municipal establishments had been, as heretofore, carried out by the Committee; a revenue of £2734 having been derived from it.

The city, he added, was at present lighted by means of the following lamps: Electric: Arc, 188; incandescent, 84—272. Incandescent gas: Four and three light, 69; two-light, 2013; one-light (full time), 7799; one-light (extinguished at midnight), 4137—14,018. Flat-flame burner lamps: 4-feet lamps, 1553; 2-feet lamps, 2988—4541. Total, 18,821. To deal with the lighting of these lamps, 176 lamplighters had been employed under the supervision of fourteen foremen; while the entire work of maintenance of the columns and lamps had been carried out by 70 inspectors, mechanics, &c.

The matter of the Fazakerley Gas-Works, the Chairman concluded by saying, is now awaiting the Local Government Board inquiry for the borrowing of £25,000 for the erection of the works; and it is expected that the inquiry will be held shortly.

THE PROPOSED GAS TRANSFER AT SELKIRK.

Negotiations to be Continued.

At a Meeting of the Selkirk Town Council on Monday of last week —Provost Sim presiding—a report was put in by the Special Committee on the acquisition of the gas undertaking, in which it was intimated that the offer of the Council had not been accepted. A recommendation was submitted that, while the offer made by the Council be not increased in any way, the Company be informed that, within the limits of that offer, the Council were prepared to meet them in any reasonable way.

Provost Sim stated that what happened at the meeting of the Gas Company's shareholders threw considerable light on the subject before them. The meeting began with the recommendation by the Directors that the Council's offer should be declined; the reason for this recommendation being that they did not like the annuities and the deferred bonds. After discussion, it was stated that there was a further reason for recommending that this offer should be declined. The shareholders were of opinion that the time had now come when they ought to receive a larger share in the prosperity of the Company than they had had up to that time. It was explained that this could be managed in a variety of ways. For instance, they might pay a larger dividend than in the past, or write up the capital, or float the concern as a limited liability Company. He thought there were only three of the shareholders who were apparently in favour of accepting the Council's offer. One of them, Mr. Watson, was in favour of accepting provided he was satisfied that the shares would be saleable, and that the Council would pay the annuities free of income-tax. A motion in favour of the recommendation of the Directors was carried by about nine votes to two. The Provost proceeded to say that he had little doubt, from what transpired at the meeting, that if the decision had not been previously arranged, and if proxies in favour of the decision had not been in the hands of the Directors, the result, while it might not have been the acceptance of the Burgh's offer, would not have been its unconditional refusal. It was with the greatest reluctance that he dealt with the question, because he did not look upon it as entirely settled. They would see from the recommendation that they were still willing to negotiate; and he was not without hope they might ultimately come to an arrangement,

He felt very decidedly that it was of considerable importance that the motion before them should be carried. He was sure that the two gentlemen who had opposed it on the last occasion would excuse him if he took this opportunity of pressing upon them the responsibility of their decision at the present time. He would ask them in the first place whether they had gone carefully into the accounts of the Company, whether they had satisfied themselves as to the amount which the Company were getting from the burgh, with profits and surplus year by year; and whether they had satisfied themselves that the cost of what they were offering, year by year, from the burgh, would be greater than the amount which the Gas Company were now taking. Another question was whether they had considered how much more the Company were likely to take from the burgh in the future than they had done in the past, because this was a very important element in the case. They had not only to do with what the Company had hitherto been getting, but also with what they were likely to get in the future; and if they had to oppose the Company getting more in the future than in the past, how were they going to manage it? It was not sufficient to say that they did not think this was a particularly good bargain for the burgh. What they had to do was to say how they were going to do better for the burgh. The Gas Company were an ordinary private company enjoying a monopoly. Up to the present they had enjoyed the monopoly with very considerable limitation. A good many years ago they entered into an agreement with the manufacturers whereby they undertook not to distribute more than 10 per cent., and not to lay aside more surplus than was considered necessary for certain special objects. The result had been that the consumers were getting gas for 2s. 8½d. per 1000 cubic feet—he was not sure that it was not 2s. 6d. just now; while other burghs less favourably situated had been paying a good deal more. Their price arose directly out of this agreement. Nearly every other company in Scotland had watered their stock, at least once—some of them more than that. It was largely due to the agreement that the Company had not watered their stock. The Gas Company considered that the agreement was now concluded, and that they could charge whatever price for gas they thought proper. There was nothing whatever to hinder them taking another £1000 a year out of the burgh for gas. This looked a big sum; but it only represented 7d. on the price of gas. If they took the price of gas at 2s. 8½d. per 1000 feet, and added 7d., that gave them 3s. 3½d. In the burgh of Peebles they had been increasing the consumption by leaps and bounds; and the price was 3s. 4d. It was perfectly clear that the Gas Company, provided that they were allowed to do it, could easily take another £1000 a year out of the concern. How were they going to prevent them doing that? The Company had their pipes in the Council's districts, and the Council could say that they were not going to allow the Company to have them there any longer. The Company might say that they had a right to have their pipes there. If they took another point, that of building works of their own, the Company would probably say that under the Gas Act the Council had no power to do this. The Council would say that they had; and possibly the matter would have to be fought in court, entailing considerable expense. The Council could say that they would go to arbitration. But, unfortunately, there was no certainty as to what they would have to pay in that case. It certainly seemed to him that the burgh and the Gas Company should come to some arrangement. He did not think the Council had met the Company in any grudging way. The Company's shares had been selling in the market at £11. He believed that one man had actually paid £12; but in the ordinary way £11 had been the price. The shareholders had been receiving a 10 per cent. dividend. They were offering the Company 12½ per cent. upon the security of the burgh. They were offering what was equal to £16 per share, against £11, which they received just now. The Committee had gone carefully into the figures, and they were satisfied that the burgh would not lose by making the bargain. He formally moved the adoption of the recommendation.

Councillor Roberts, in seconding, said that along with the Provost and Treasurer Bolster he had gone into the figures with the greatest care; and although he was against the proposal at the beginning, he was satisfied that the time had come when the town should buy up the Gas Company or leave it altogether. If they allowed this opportunity to pass, they would probably in after-years think that they should even have paid more, or that they were fools to let it go. Councillor Reekie said it was apparent that the movers of the scheme were determined by hook or by crook to get the Council to purchase the gas-works. They had already made two offers, and both had been refused. They came before them that night again asking them to accept a recommendation for a third trial. The people were perfectly satisfied with the present state of affairs. How was it possible for the Corporation to erect new gas-works? They would require £20,000 to do this. Then how could they compete with the present Company, with their capital behind them? Such an idea might be put away at once. He thought the Council had begun at the wrong end. In the first place, they ought to have consulted the ratepayers before making any proposals for giving a sum for the gas undertaking. Again, it was gas just now; but they did not know what it would be in a short time. He moved that no further negotiations be entered into with the Gas Company until after the election. Treasurer Bolster said that Mr. Reekie had on previous occasions expressed admiration for the business acumen of the Directors of the Company. He had no fault to find with this. He considered that they had done well for Selkirk, besides doing well for themselves. But it was the future they had to look to. They had the statement that the Directors might do better for themselves than they had done in the past—that was, better for the Company, but worse for the Council. Mr. Reekie had said that he had not met a single individual in favour of the gas-works being taken over. He had met a good few who were willing to take them over. But the ratepayers had only heard one side of the story. How could they judge on that, especially when the Council were precluded from giving the other side? He was not supporting the movement because he was a municipalizer in principle, but because he believed it was in the best interests of the burgh.

On a division the motion of Provost Sim was adopted—only three voting against it.

NEW TRADE CATALOGUES.

The Davis Gas-Stove Company, Limited, have sent an attractive booklet showing their newest designs of "Diamond" and "Trident Burner" fires, steam-radiators, and condensing stoves. The particulars are preceded by a few remarks on the features of the stoves, some useful hints on adjusting the regulators, packing the fuel, &c., and a view of the Company's new works at Luton, which were illustrated in the "JOURNAL" a fortnight ago.

A new illustrated and descriptive catalogue of incandescent gas-fittings and accessories, &c., has been issued by the Wholesale Fittings Company, Limited. The first pages are devoted to various kinds of mantles, and they are followed by illustrations of inverted and other burners, self-lighters, chimneys, screens, and globes, in great variety. There is shown a large assortment of fancy brackets for ordinary and inverted burners, hall and other lanterns, pendants, shop lights, and tools. The articles described and illustrated occupy 96 quarto pages.

We have received from Messrs. Falk, Stadelmann, and Co., Limited, their new catalogue (No. 256) of gas-fittings and accessories, including their "Veritas," "Pharos," and other high-power lamps and lanterns. The book consists of nearly 300 large quarto pages, and it affords striking evidence of the great variety of goods embraced in the firm's operations. On pages 88 to 142 will be found a comprehensive range of fittings suitable for inverted burners, of both the pendant and bracket types. Two of the designs shown can easily be adapted for the ordinary "C" burners; and with other patterns an adapter-like arrangement is supplied whereby the pendants can be used either for the pendant inverted burner or for the bracket type. Special consideration has been given to fittings for converting billiard pendants; and a range of goods of the Adam period, to suit the prevailing demand for this style of decoration, is shown on art paper. Particular importance is attached to the "Universal" inverted cluster arrangement illustrated on p. 202, whereby street-lamps can be readily converted from either the flat-flame or the upright burner type to the more modern inverted burner system. The "Metropolis" upright burner, illustrated on p. 204, is specially suited for street-lamps if upright burners are preferred, and is adaptable to practically any pressure. Towards the end of the book will be found a number of illumination devices, gas-stoves of different kinds, and radiators. The catalogue is for use in conjunction with the subsidiary incandescent issue, No. 257, which has already been published.

PATENTS AND DESIGNS ACT, 1907.

A Useful Summary.

In the latest issue of the "Board of Trade Journal," the attention of manufacturers and traders is specially called to the following summary which is given of certain of the provisions of the Patents and Designs Act, 1907.

Revocation of Patents Worked Wholly or Mainly Abroad.—Section 27 of the Act provides that at any time not less than four years after the date of a patent, and not less than one year from the passing of the Act—*i.e.*, from Aug. 28 last—any person may apply to the Comptroller for the revocation of the patent on the ground that the patented article or process is manufactured or carried on exclusively or mainly outside the United Kingdom. If, after inquiry, the Comptroller is satisfied that the allegations contained in any such application are correct, he may, subject to an appeal to the Court, revoke the patent, unless the patentee proves that the patented article or process is manufactured or carried on to an adequate extent in the United Kingdom, or gives satisfactory reasons why it is not. A year's grace, dating from Aug. 28 last, has been given by this section in the Act. This interval has been allowed in the hope that the patentees, unless prevented by satisfactory reasons, will at once take the necessary steps to work their patents to an adequate extent in the United Kingdom. In the event of their failing to do so, they will run the risk of losing their monopolies, not only by means of the legislative machinery provided by section 27, but also by the operation of section 25 (2), which has authorized the Law Courts to take cognizance of their default, and has provided that every ground on which a patent may be revoked under the Act by the Comptroller shall also be available by way of defence to an action for infringement, and shall also be a ground of revocation under that section.

Cancellation of Copyright in Registered Designs Used in Manufacture Wholly or Mainly Abroad.—Provisions similar to those in section 27 of the Act are to be found in section 58, with reference to the cancellation of registrations of designs used in manufacture wholly or mainly abroad. A year's grace has not been allowed by this section, which will come into force on Jan. 1 next, nor is there any appeal against the decisions of the Comptroller under it. The grounds for cancellation of registration of a design under this section are made available by way of defence to an action for infringement of copyright in the design.

Compulsory Licences and Revocation.—Another amendment of the law relating to obstructive patents will be found in section 24, which provides that petitions to the Board of Trade for the grant of compulsory licences, or in the alternative for the revocation of patents on the ground that the reasonable requirements of the public with respect to a patented invention have not been satisfied, shall, if the Board of Trade are satisfied that a *primâ facie* case is made out, be referred to the Court—*i.e.*, to a specially selected Judge of the High Court or to a Lord Ordinary in Scotland, instead of, as at present, to the Judicial Committee of the Privy Council. For the purposes of this section, the reasonable requirements of the public are not to be deemed to be satisfied (*a*) if by reason of the default of the patentee to manufacture to an adequate extent and supply on reasonable terms the patented article, or any parts thereof which are necessary for its efficient working, or to carry on the patented process to an adequate extent, or to grant licences on reasonable terms, any existing trade or industry or the establishment of any new trade or industry in the United Kingdom is unfairly prejudiced or the demand for the patented article or the article

produced by the patented process is not reasonably met; or (*b*) if any trade or industry in the United Kingdom is unfairly prejudiced by the conditions attached by the patentee before or after the passing of the Act to the purchase, hire, or use of the patented article, or to the using or working of the patented process.

Avoidance of Certain Conditions Imposed by Patentees in Relation to the Sale or Lease of or Licence to Use Patented Articles or Processes.—Attention is called to section 38 of the Act which deals with this matter. Broadly speaking, the conditions prohibited are those having the effect of preventing purchasers, lessees, or licensees of patented articles and processes from buying or using other articles or processes and availing themselves of other inventions, or of compelling them to acquire from the patentee or his nominees articles that are not protected by his patent. Subject to certain specified exceptions, section 38 renders any conditions of this character inserted in contracts made after the passing of the Act null and void, as being in restraint of trade and contrary to public policy, and enables existing contracts containing them to be determined on payment of compensation. The section also provides that the insertion by the patentee in a contract made after the passing of the Act of any condition which by virtue of the section is null and void shall be available as a defence to an action for infringement of the patent to which the contract relates brought while that contract is in force.

Other Provisions.—The Act contains a large number of provisions which will improve the position of existing and future patentees and proprietors of registered designs. For the details of these provisions the Act itself should be consulted. Reference may, however, be made to section 18, the object of which is to reduce the cost of extending the time of a patent where a patentee has been inadequately remunerated; section 19, enabling patentees to obtain patents of addition in respect of which no renewal fees will be payable; section 20, dealing with the restoration of lapsed patents; sections 41 (2) and 55, protecting a patentee or proprietor of a design against the consequences of unauthorized publication of his invention or design; and section 53, enabling copyright in a design to be extended for a second or third term of five years.

LIVERPOOL CORPORATION WATER SUPPLY.

The Work of the Year.

The Water Committee of the Liverpool Corporation held their final meeting for the year last Tuesday, when the Chairman (Alderman Burgess), in responding to a vote of thanks accorded to him for his services, reviewed, as on previous similar occasions, the progress of the water undertaking.

Alderman Burgess began by thanking the Deputy-Chairman (Colonel Porter), the members of the Committee, the Engineer (Mr. Joseph Parry, M.Inst.C.E.), and the staff, for their loyal and capable assistance. He said the progress of the undertaking continued to be quite satisfactory. The number of new tenants supplied with water within the compulsory limits, not including Chorley, during the twelve months ending the 30th of September had been 2579, against 2533 the previous year. In this area the estimated population was 899,000; and as they also supplied water in bulk to 188,000 people outside the Liverpool compulsory area, and in detail to 29,000 people in Chorley, the total population supplied from the works was now 1,116,000, or about 13,000 more than twelve months ago. The total quantity of water supplied from the works during the year had been 11,089,743,000 gallons—an increase of 337,747,000 gallons over the previous year, or an average of 6,495,000 gallons per week. This was about double what they had been accustomed to regard as the normal rate. There had been a gratifying advance in the trade and shipping supplies. The quantity sold by meter for trade and manufacturing purposes in the city and suburbs had been 2,566,682,000 gallons—a rise of 44,497,000 gallons; while shipping had taken 247,438,300 gallons, or 10,791,000 gallons more. The quantity of water sold by meter along the lines of the Rivington and Vyrnwy aqueducts had been 1,003,797,000 gallons—an increase of 96,340,000 gallons. About 14¼ miles of new mains had been laid in and around the city during the twelve months. The construction work had been much smaller than for several years past; and now that the second line of pipes had been laid, they might look forward to a period of comparatively small capital expenditure for some years to come. The principal constructions in progress were the covering of the goit at Rivington—an urgent work which was now nearly completed; the Marchnant Tunnel, which was also in a very advanced condition; and the provision of additional filter-beds at Oswestry. Two matters which the Committee ought to consider carefully in the near future were the Engineer's plans for dealing with the Vyrnwy water before it entered the pipes at Hirnant, and the provision of further reservoir accommodation at Malpas. It had been necessary to culvert and fence streams in Lever Park to protect the purity of the water; and this work had now been completed. The periodical chemical analysis made by Professor Campbell Brown and the daily bacteriological analysis made by Sir Robert Boyce showed that the high standard of purity of the Liverpool water had been constantly maintained. They had continued the planting of trees at Lake Vyrnwy and at Rivington; and in both places the nurseries and larger trees were progressing satisfactorily. Liverpool was regarded throughout the country as the pioneer in the matter of watershed afforestation; and a great deal of interest was shown in what they had accomplished at the recent National Conference on the subject, which was called together by the Board of Agriculture. After the rejection by the City Council of the arrangement made by the Water Committee with the Birkenhead Corporation for a supply of water to that borough, the Birkenhead authorities decided to apply for parliamentary sanction for a gravitation scheme of their own; and their Bill as originally drawn—and, indeed, as sanctioned by the House of Lords—contained provisions which might have jeopardized Liverpool's arrangements with Wallasey. They were able, however, to convince the Committee of the House of Commons of the undesirability of permitting in the same district unrestricted competition between two Corporations for the supply of water; and a clause was inserted which in some degree protected Liverpool's interests. He had no desire to criticize again the decision of the City Council on this subject; but he was sure it was a matter for regret that an arrangement could not have been arrived at which would have obviated the need for a large capital expenditure by their neighbours on the other side of the river, and which would have done something to bind together the population of this great Mersey port, which had many identical interests.

GAS COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 229.

Issue.	Share	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
500,000	10	Oct 11	10½	Alliance & Dublin 10 p.c.	20–21*	..	5 0 0
268,324	10	,,	7½	Do. 7 p.c.	13–14*	..	5 7 2
200,000	5	May '5	7	Bombay, Ltd.	6¾–7	..	5 0 0
40,000	5	,,	7	Do. New, £4 paid	4¾–5¼	..	5 6 8
50,000	10	Aug. 29	14	Bourne- mouth Gas & Water 10 p.c.	27½–28½	..	4 18 3
51,810	10	,,	7	Do. B 7 p.c.	16¾–17¼	+¼	4 1 2
53,200	10	,,	6	Do. Pref. 6 p.c.	14½–15½	..	3 17 5
380,000	Stk.	Aug. 15	12½	Brentford Consolidated	246–251	–1	4 19 7
300,000	,,	,,	9½	Do. New	185–190	..	5 0 0
50,000	,,	,,	5	Do. 5 p.c. Pref.	115–120	..	4 3 4
206,250	,,	June 13	4	Do. 4 p.c. Deb.	100–101	..	3 17 8
220,000	Stk.	Sept. 27	11½	Brighton & Hove Orig.	215–220	..	5 2 3
246,320	,,	,,	8½	Do. A. Ord. Stk.	155–160	..	5 3 2
460,000	20	,,	10	British	40⅝–41½	..	4 16 5
104,000	Stk.	Aug. 15	6	Bromley, Ord. 5 p.c.	116–119	..	5 0 10
165,700	,,	,,	4½	Do. do. 3½ p.c.	87–90	..	5 0 0
500,000	10	Oct. 11	7	Buenos Ayres (New) Ltd.	10⅞–11¼*	..	6 4 5
250,000	Stk.	June 27	4	Do. 4 p.c. Deb.	93–95	..	4 4 3
150,000	20	July 12	8½	Cagliari, Ltd.	26½–27½	..	6 0 0
100,000	10	—	—	Cape Town & Dis., Ltd.	6–8	–2	—
100,000	10	Apl. 26	4½	Do. 4½ p.c Pref.	8–9	..	5 0 0
50,000	50	May 2	6	Do. 6 p.c. 1st Mort.	50–52	..	5 15 5
50,000	Stk.	June 27	4½	Do. 4½ p.c. Deb. Stk.	94–96	..	4 13 9
157,150	Stk.	Aug. 15	5	Chester 5 p.c. Ord.	106½–108½	..	4 12 2
1,443,280	Stk.	,, 29	5⅛	Commercial 4 p.c Stk.	101–106	..	4 18 1
560,000	,,	,,	5	Do. 3½ p.c. do.	98–103	..	4 17 1
475,000	,,	June 13	3	Do. 3 p.c. Deb. Stk.	81–83	..	3 12 3
800,000	Stk.	,,	6¼	Continental Union, Ltd.	112–1.7	..	5 11 1
200,000	,,	,,	7	Do. 7 p c. Pref.	138–143	..	4 17 11
460,170	Stk.	—	5½	Derby Con. Stk.	123–125	..	4 8 0
55,000	,,	—	4	Do. Deb. Stk.	102–104	..	3 16 11
486,090	10	July 31	12	European, Ltd.	22½–23¾	..	5 2 2
354,060	10	,,	12	Do. £7 10s. paid	17½–18½	..	4 17 4
15,182,590	Stk.	Aug. 15	4 1/16	Gas-light and Coke 4 p.c. Ord.	94–96	..	4 11 7
2,600,000	,,	,,	3⅛	Do. 3⅛ p.c. max.	86–88	..	3 19 7
3,799,735	,,	,,	4	Do. 4 p.c. Con. Pref.	104–107	..	3 14 9
4,193,975	,,	June 13	3	Do. 3 p.c. Con. Deb.	81–83	..	3 12 3
258,740	Stk.	Sept. 13	5	Hastings & St. L. 3½ p.c.	93–95	..	5 2 0
82,500	,,	,,	6½	Do. do. 5 p.c.	114–117	..	5 11 1
70,000	10	Oct. 11	11	Hongkong & China, Ltd.	19–20*	+½	5 10 0
4,940,000	Stk.	May 15	8	Imperial Continental	176–178	..	4 9 11
473,600	Stk.	Aug. 15	3½	Do. 3½ p.c. Deb. Red.	91–93	..	3 15 3
195,242	Stk.	Aug. 29	6	Lea Bridge Ord. 5 p.c.	110–120	..	5 0 0
306,083	,,	June 27	4	L'rpool Unit'd Deb. Stk.	108–110	..	3 12 9
£			p.c.				£ s. d.
561,000	Stk.	Aug. 29	10	Liverpool United A	221–223	..	4 9 8
718,100	,,	,,	7	Do. B	160½–16 ½	..	4 6 8
152,736	Stk.	Feb. 14	7⅞	Maidstone 5 p.c.	142–147	..	5 3 8
75,000	5	June 27	5	Malta & Medn., Ltd.	4–4½	..	5 11 1
560,000	100	Oct. 1	5	Met. of 5 p.c. Deb.	100–102	..	4 18 0
250,000	100	,,	4½	Melbourne 4½ p.c. Deb.	100–102	..	4 8 3
541,920	20	May 30	3½	Monte Video, Ltd.	10½–11½	..	6 1 9
1,775,892	Stk.	Aug. 15	4⅝	Newc'tle & G'tesh'd Con.	107–108	..	4 5 7
406,025	Stk.	June 27	3½	Do. 3½ p.c. Deb.	89–91	–½	3 16 11
15,000	10	Aug. 29	10	North Middlesex 10 p.c.	19½–20½	..	4 17 7
55,940	10	,,	7	Do. 7 p.c.	13–14	..	5 0 0
300,000	Stk.	Apl. 26	8	Oriental, Ltd.	140–145	..	5 10 4
60,000	5	Sept. 13	7	Ottoman, Ltd.	5⅞–6⅜	..	5 12 0
398,490	5	May 15	7	Primitiva Ord.	6¾–7¼	..	4 16 7
796,980	5	July 31	5	Do. 5 p.c. Pref.	5–5½	..	4 15 3
488,900	100	June 1	4	Do. 4 p.c. Deb.	94–96	..	4 3 4
1,000,000	10	Oct. 11	8	River Plate Ord.	13–13⅛*	..	5 18 6
312,650	Stk.	June 27	4	Do. 4 p.c. Deb.	94–96	..	4 3 4
250,000	10	Sept. 27	8	San Paulo, Ltd.	13–13½	+¼	5 18 6
125,000	50	July 1	5	Do. 5 p.c. Deb.	48–50	..	5 0 0
135,000	Stk.	Sept. 13	10	Sheffield A	242–244	..	4 2 0
209,984	,,	,,	10	Do. B	242–244	..	4 2 0
523,500	,,	,,	10	Do. C	242–244	..	4 2 0
70,000	10	June 13	10	South African	15–16	..	6 5 0
6,429,895	Stk.	Aug. 15	5½	South Met., 4 p.c. Ord.	119–121	..	4 10 11
1,895,445	,,	July 12	3	Do. 3 p.c. Deb.	81–83	..	3 12 3
201,720	Stk	Sept. 13	8	South Shields Con. Stk.	155–157	..	5 1 11
605,000	Stk.	Aug. 15	5½	S'th Suburb'n Ord. 5 p.c.	114–117	..	4 14 0
60,000	,,	,,	5	Do. 5 p.c. Pref.	117–120	..	4 3 4
117,058	,,	July 12	5	Do. 5 p.c. Deb. Stk.	120–125	..	4 0 0
502,310	Stk.	May 15	5	Southampton Ord.	107–112	+2	4 9 3
120,000	Stk.	Aug. 15	6⅔	Tottenham A 5 p.c.	120–123	..	5 9 9
398,940	,,	,,	5¼	and B 3½ p.c.	100–103	..	5 1 11
149,470	,,	June 27	4	Edmonton 4 p.c. Deb.	99–101	..	3 19 3
182,380	10	June 13	8	Tuscan, Ltd.	10¾–10⅞	..	7 8 10
149,900	10	July 1	5	Do. 5 p.c. Deb. Red.	100–102	..	4 18 0
193,742	Stk.	Aug. 29	5	Tynemouth 5 p.c. max.	107–109	..	4 11 9
30,000	Stk.	Feb. 14	8	Wands- A 5 p.c.	—	..	—
255,636	,,	Aug. 15	6½	worth B 3½ p.c.	128–133	..	4 17 9
75,000	,,	,,	5⅝	and C 3½ p.c.	—	..	—
80,075	,,	June 27	3	Putney 3 p.c. Deb. Stk.	77–80	..	3 15 0
845,872	,,	Aug. 15	5⅛	West Ham 5 p.c. Ord.	102–105	..	4 17 7
185,000	,,	,,	5	Do. 5 p.c. Pref.	118–120	..	4 3 4
228,300	,,	June 27	4	Do. 4 p.c. Deb. Stk.	101–104	..	3 16 11

Prices marked * are "Ex div."

NOTES FROM SCOTLAND.

From Our Own Correspondent.

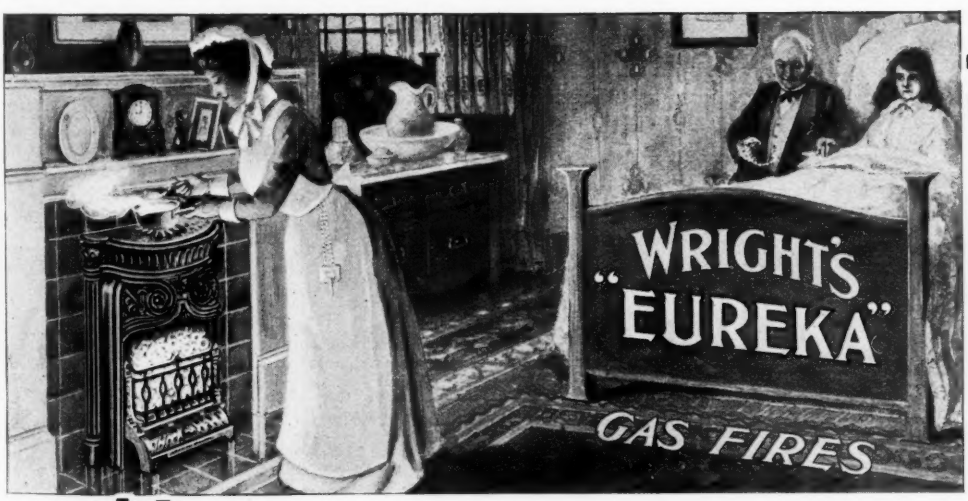
Saturday.

The abstract of the accounts of the Town Council of Kilmarnock for the year ending May 15 were laid before the Council last week. The first of the revenue-producing departments dealt with was that of the gas undertaking. It was shown that the total revenue amounted to £26,763, or an increase of £1191. From the sale of gas there was derived £21,042, or an increase of £488, the price of gas remaining the same (2s. 8½d. per 1000 cubic feet); from tar and sulphate of ammonia, £3362; and from char, £1909. The sale of stoves and fires realized £54; and the hire of stoves and fires, £128. The total expenditure amounted to £22,175, which left a surplus of £4588. Included in the expenditure were the items: Coal, £9131; lime, £454; retorts, £163; maintenance of works, £1388; wages of workmen, £5778; and cartage, £206. The total expenditure upon the manufacture of gas was £17,701, or an increase of £1059. Distribution cost £1842, or an increase of £450; but of this increase, £209 represents a new charge of 10 per cent. upon the value of stoves purchased during the year. Interest amounted to £1983; and there was paid to the sinking fund £1450. The deficiency on the Electricity Department, made good out of the surplus upon gas, amounted to £831, or a decrease of £210. The sinking fund now amounts to £3104. The capital expenditure during the year was £7425; and the account now stands at £93,158. The expenditure upon the new works has amounted to £46,979. The quantity of gas made was 168,431,000 cubic feet, or an increase during the year of 4,295,000 feet; and the gas accounted for was 154,524,869 feet, or 3,556,559 feet more. The make per ton of coal was 9300 cubic feet; and the unaccounted-for gas was at the rate of 8·25 per cent.

At the meeting of the Corporation, the minutes of the Gas Committee stated that, reference having been made to the practice of sending employees to assist and supervise work at neighbouring gas undertakings, it was agreed that in future the Gas Managers should submit all applications for such assistance to the Committee, except in cases of emergency, when the consent of the Convener was to be asked. Mr. T. Smith said he had ascertained that a man in the employment of the Corporation had drawn plans for an extension of the New Cumnock Gas-Works, and that another employee had been away there for three months. He held that this was a state of affairs which should not be allowed by the Town Council, but that the Gas Committee should be consulted in all these matters. The fact that gas managers had power to send men to other works, placed an opportunity before them to take work outside Kilmarnock; and while he would not say that Messrs. Fairweather did this, yet he thought the opening was there, and such a state of things should not be allowed to exist. Mr. R. Muir, the Convener, said it was quite true that one of their men prepared plans for the New Cumnock Gas-Works; but the work was done in his own time. As for the other man, he was sent in a case of emergency; and they themselves had sometimes to get a man from another works in similar circumstances. Besides, it was in the summer time, when they were by no means busy; and it was a saving to the Corporation, because the New Cumnock people paid the man's wages. This was a case of use and wont; and it was one of the privileges of all gas managers that they were allowed to consult and advise. The Manager had told them that he was quite willing to acquaint the Committee in the future before anything of the kind was done. As for Mr. Warnock, who prepared the plans, he had been a valuable man to the Corporation, and he had now secured an appointment in South America, at a salary three times larger than he had in Kilmarnock. In the course of further conversation upon the subject, Mr. Climie said it was quite within the knowledge of many members of the Council that their Gas Managers were Consulting Engineers for other gas-works throughout the country; and Bailie Muir said it seemed to him to be a good certificate of character to their Managers that their advice was sought from outside. It proved that their Managers were among the best in the country.

The negotiations for the transfer of the Selkirk Gas Company's undertaking, which, according to the last announcement, seemed to have gone all awry, have received a new lease of life in the proceedings which took place in the Town Council this week, an account of which is given on another page. There is a section of the Town Council who are opposed to the transfer—I suppose it may be said on any terms. The other section, by far the majority, are in favour of the transfer—on public grounds. Consequently, their desire is, notwithstanding the refusal of the shareholders of the Gas Company to accept the offer of the Corporation, to continue the negotiations. The majority of the Council are convinced that they are offering liberal terms to the Gas Company, and that the difference between them is only one of detail and not of principle. There is a feature about this negotiation which is worthy of attention, and it is that there is no recrimination in the business. It is freely acknowledged that the Gas Company have served the community well, and that the Company are, therefore, worthy of every consideration. The Council seem to be offering very fair terms to the Company; and the Company, with certain assurances, seem to be prepared to accept them. If details could be adjusted, there would seem to be little doubt that the Council's offer will be accepted; and that the transfer will go on. The parties are not engaged in an arm's-length controversy, but rather in a friendly conference; and if common sense continues to rule their negotiations, there is no reason to fear that they will not arrive at a conclusion satisfactory to both parties.

In the Greenock Town Council last Tuesday, Mr. Forbes, who moved the adoption of the minutes of the Gas Committee, referring to the frequent complaints he had received lately about the quality of the gas, said the tests reported gave about the usual average. Sometimes the gas varied a little from day to day; but the fact was that they must increase the facilities for bringing gas into the town, and improve the pipes in many properties, before they could get the full supply that was wanted. Bailie Bailey said there was no doubt whatever that there had been serious complaints about the gas. Statistics might show a very fair pressure and a very good average rate of candle power; but the fact remained that some of the inhabitants of Greenock had suffered



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severely from the want of sufficient light even to read a newspaper. It might be the poorer quality of the coal that was to blame. Mr. MacOnie said that at one time, when complaint was made, the Gas Department sent men to clean out the pipes which led from the main in the street. In many cases the pipes were found to be choked. He would like to ask the Convener if this practice remained—not at the cost of the landlord, nor even of the tenant, but at that of the Gas Trust. Mr. Forbes, in reply, said there had been a large expenditure in connection with the gas-works; and when the Engineer gave in his report, three years ago, as to the requirements of the undertaking, a new main was part of the estimate. Men were sent out to clean service-pipes. This season they cleaned out 900 pipes; and in forty-nine cases out of fifty where complaints had been made about insufficient supply of gas, the clearing out of the service-pipes had removed the trouble.

The Gas Committee of the Arbroath Town Council reported on Monday that they had visited the works, and inspected new plant put down there, and other works, consisting of a new station meter, to pass a million cubic feet of gas per day, with 15-inch pipes and bye-pass connections; a 10-inch safety bye-pass governor and 10-inch pipes connected to a 10-inch pipe in Ponderlaw Street; the removal of the smithy to the interior of the retort-house; the enlargement of the office accommodation by adding thereto the old show-room; the fitting up of a new show-room; the re-facing of the building in which the station meter, the engines, and the new show-room are placed; and two 8-inch retort-house governors, placed on the hydraulic main. An arrangement has now been made whereby, in case of accident at the outlet of the holder from which the gas is at present passed down Abbot Street to the town, the new safety bye-pass governor will open automatically and pass the gas from the holder, through the inlet-pipes, to the town, by Ponderlaw Street, and so prevent the gas supply being entirely cut off. The Committee found the works to be highly improved, both in efficiency and in outward appearance; and they expressed their high satisfaction with the manner in which the Manager had carried through the alterations and improvements. The Manager stated he was of opinion that the erection of a plant suitable for testing coal in quantities of 22 lbs. or thereabouts per charge would be profitable to the Corporation. He had received a quotation of £90 for such plant; and about £20 more might be required for connections and the like. The Committee approved of the Manager's suggestion, and authorized him to visit one or two other gas-works, to see the latest plant of the sort in use.

The Lockerbie Town Council have reduced the price of gas for power, heating, and cooking purposes, as from Nov. 1, by 10d. per 1000 cubic feet, making it 4s. 2d.

I learn that the Airdrie process of revivifying purifying material *in situ* has been introduced into several gas-works in Scotland, with gratifying success. In some cases, eleven and twelve months have elapsed without any of the purifier-boxes requiring to be opened. At Musselburgh, where the process was started last May, it has worked most satisfactorily; there having been no necessity for the opening of a purifier-box since then.

CURRENT SALES OF GAS PRODUCTS.

Sulphate of Ammonia. LIVERPOOL, *Oct.* 19.

There has been a strong demand during the week, and a good business has been done, both for prompt and forward delivery, with the result that prices have experienced a further advance. Leith is the point where requirements have been most urgent, some large shipments having to be made from that port absorbing present supplies, and other shipments intended from there have had to be diverted, thus creating a firmer tone all round. At the close, quotations are £11 17s. 6d. per ton f.o.b. Hull, £12 1s. 3d. to £12 2s. 6d. per ton f.o.b. Liverpool, and £12 5s. per ton f.o.b. Leith. In forward delivery, considerable sales have been made, principally in Scotland, at £12 5s. per ton f.o.b. for all periods into next year; but at the close sellers decline to go on at this figure for the early months, requiring an advance.

Nitrate of Soda.

This article is steady at 11s. 3d. per cwt. for ordinary and 11s. 6d. for refined.

Tar Products. LONDON, *Oct.* 21.

The markets are quiet, without much alteration in prices. In pitch, Continental orders are very scarce, especially for near delivery. South Wales consumers are also well bought up to June, 1908, and they will not offer more than prompt prices for July-December, 1908. In London, the value remains about 25s. 6d. per ton for prompt delivery; while upon the east and west coasts, prices range between 24s. and 25s. per ton. Creosote is very firm; but there appears to be some quantity now for disposal in London, for immediate delivery, at reasonable figures. This is the oil which was short-shipped on the large boat which has recently been loading here, but which did not take so much as was expected would be the case. In the Midlands, 3d. per gallon is the ruling figure; and in the North, 2⅝d. to 2¾d. remain the quotations. Benzol, 90 per cent., is very quiet, and business has been done at 8¼d., and 8½d. for delivery all over 1908, on the east coast. Benzol, 50 to 90 per cent., and toluol are very difficult of sale, and no business is reported in either. Solvent naphtha is easy, and prices range from 1s. on the east coast to 1s. 1d. in London for country qualities; and 1s. 1½d. is about the ruling price for London makes. Nothing much of interest is reported in anthracene. Carbolic, 60's, is still steady for this year's delivery, but is easier for forward.

The average values during the week were: Tar, 15s. to 19s., *ex* works. Pitch, London, 25s. to 25s. 3d.; east coast, 24s. 6d. to 24s. 9d.; west coast, 23s. 9d. to 24s. 9d. Benzol, 90 per cent., 8⅛d. to 8⅜d., casks included; benzol, 50-90 per cent., 8½d. to 9d., casks included. Toluol, 10d. to 10½d., casks included. Crude naphtha, 4d., naked; solvent naphtha, 1s. to 1s. 1½d., casks included; heavy naphtha, 1s. 1d. to 1s. 2d., casks included. Creosote, London, 2⅝d. to 2⅞d., naked; North, 2¾d. to 2⅞d., naked. Heavy oils, 3⅛d. to 3¼d., naked. Carbolic acid,

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60 per cent., 1s. 8d. to 1s. 8½d., casks included. Naphthalene, £6 10s. to £10 10s., packages included; salts, 37s. 6d. to 42s. 6d., packages included. Anthracene, "A" quality, 1½d. to 1¾d., casks included.

Sulphate of Ammonia.

This market has improved about 1s. 3d. to 2s. 6d. per ton all round during the past week. Outside London, makes of ordinary quality rule at about £11 15s. on Beckton terms; but one of the best makes has been sold at £12 on these conditions. The principal London Gas Companies still quote £12 2s. 6d. to £12 5s. In Leith, business has been done at £12 2s. 6d., and also at £12 3s. 9d., for prompt delivery, and £12 3s. 9d. has also been declined. For forward delivery, £12 5s. has been offered by consumers without success. In Hull, £11 16s. 3d. is about the ruling value for ordinary quality, and business has been done at £11 18s. 9d. for a superior make. In Liverpool, £11 18s. 9d. to about £12 are the ruling figures.

COAL TRADE REPORTS.

Lancashire Coal Trade.

There is a better inquiry for steam coal and cannel, and rather more metal is going out on contract. It calls, however, for no special comment. It is what is expected as "Dark November" approaches. House coal is a little quieter on account of the mild weather prevailing, and due also to the substantial stocks got in by those who could afford to buy in advance just before the recent rise in prices. Next month, coal owners expect a decided increase in orders for this class of fuel. For steam coal, prices at the full rate of increase are well maintained, and there is no falling off in the demand. Coal for shipping is in less request. There is no change in the general average quotations for coal at the pits as last given. Naturally, anxiety is felt as to what may be the outcome of the Railway difficulty; but it does not create undue alarm. The demand for an increase of another 5 per cent. in miners' wages came before the Coal Conciliation Board in London last Tuesday; but no decision was arrived at. The respective parties could not agree; and Lord James of Hereford is again to act as Referee. If this advance is granted, the maximum rate of wages will be reached. The prospects are in favour of the men; for never was there a better or more extensive market for coal than that now existing. The almost certain result, however, will be a further rise in prices.

Northern Coal Trade.

There has been a steady demand for coal, though inclement weather has interfered with the shipments at times. This has had its effect on the prices, which are easier for some kinds of coal. In steam coals, exports are still fairly full; and the prices for best Northumbrians are 15s. 3d. to 15s. 6d. per ton f.o.b. For second-class steams, the quotation is from 14s. 3d. to 14s. 6d., and for steam smalls from about 10s. to 10s. 9d. Work at the collieries is steady, with a few exceptions, from the cause named above. In gas coals, the demand is increasing steadily, as is usual at this season, and there are heavy deliveries on the long contracts that are running. There are also fair exports. Sales have been made of part of the supply for a French port for next year, at a price equal to 13s. 6d. per ton f.o.b. Other coal, second class, has been sold at about 12s. 9d. per ton f.o.b. for delivery over the latter half of next year; so that it is evident that some contracting forward is still taking place for gas coal, though such contracts do not seem to be quite so fully given out as they were. Coke is rather quieter, and gas coke in fuller supply. For good gas coke for export, the quotation is from about 19s. to 19s. 6d. per ton f.o.b.

Scotch Coal Trade.

Trade has been very quiet; buyers being disposed to hold off, in the expectation of getting lower prices. The shipping trade is still strong, but not quite so vigorous as it was even a fortnight ago. The business doing is reported to be chiefly the working off of old contracts, new business being small. House coal is in demand, but other sorts are getting plentiful. The prices quoted are: Ell 14s. to 16s. 6d. per ton f.o.b. Glasgow; splint 15s. 6d. to 15s. 9d., and steam 14s. to 14s. 3d. The shipments for the week amounted to 310,577 tons—an increase of 2673 tons upon the previous week, and of 32,829 tons upon the corresponding week of last year. For the year to date, the total shipments have been 11,593,119 tons—an increase of 751,447 tons.

Breaking Lamp-Glasses at Tottenham.—At the Tottenham Police Court, last Thursday, the Tottenham and Edmonton Gas Company prosecuted four persons for breaking the glass of street-lamps. One man, a shoemaker named William Pask, was sentenced to two months' hard labour; it being stated that he had been several times convicted for similar offences. Three young fellows who were caught throwing stones at lamps in Downs Lane, Tottenham, five of which they broke, were each fined 5s. and costs, and ordered to pay the damage. It was said that a great deal of injury had been done to lamps in the neighbourhood of Downs Lane; and two years ago the expense to which the Gas Company were put in this respect amounted to no less than £75.

Louth Gas Company.—Mr. W. Allison presided over the annual meeting of the Louth (Lincs.) Gas Company on Saturday, when another prosperous year was reported. The net profits amounted to £2521; and the balance to the credit of the profit and loss account was £3169. The same dividends as last year were recommended—viz., 14¼ per cent. on the original capital, 5 per cent. on improvement stock "A" and "B," and 11¼ per cent. on the new ordinary stock. This absorbed £2005; and £450 is to be placed to the contingent fund—making the total amount of this fund £1537. The report stated that more gas had been obtained from less coal than in the preceding year; the average make per ton having been 10,350 cubic feet. The increase in the quantity of gas sold was 4 per cent. on the year; and the unaccounted-for gas was only 2·19 per cent.

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34 "BLAND" Mantles in use 12 Months and still burning brightly.

St Mary's House,
Ross.
9th Oct 1907

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Sept 1905 to Sept 1906 Naked Lights } 161.300 ft. £32. 13. 3

Sept 1906 to Sept 1907 Bland Lights } 72.200 ft. £14. 16. 11

89.100 ft of Gas. less - the sum of £17. 16. 4 saved in the year.

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Yours faithfully,
Wm Watson.
Churchwarden for Parish Church

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The Geltsdale Arbitration Award.

At a special meeting of the Geltsdale Water Committee of the Carlisle Corporation held on Tuesday, the Town Clerk reported that he had received a supplemental award by the Umpire (Mr. John Farrer) on the question of the amount of compensation to be paid to the Earl of Carlisle by the Corporation in respect of the lands and easements required in connection with the carrying out of the Geltsdale water-works. The effect of the supplementary award was that Mr. Farrer confirmed the amount he had already named—viz., £17,261 14s. 2d. The Town Clerk was instructed to submit the award to Counsel for his opinion on the points of law involved. It may be remembered that Lord Carlisle originally claimed from the Corporation £33,559, of which £10,671 was for land and easements and compensation for injury in the execution of the works, and £22,888 with respect to the taking of water. The Umpire awarded the lump sum of £17,261, without stating whether anything had been allowed for water. The Corporation thereupon applied to the Divisional Court for an order remitting the award to him with instructions to state it in the form of a special case on the points of law involved. Lord Carlisle unsuccessfully appealed against the order; but it was amended by providing that the Umpire might, if he chose, hear additional evidence. At a further hearing, his Lordship adduced evidence to show that by the carrying out of the works in question he had lost the value of the special adaptability of his land for water-works purposes. The Umpire now explains that he has given the amount as compensation for the taking away of the special adaptability of the property for the construction of reservoirs and as a water-bearing area.

Pontypridd Gas Undertaking.

The accounts of the Gas Department of the Pontypridd Urban District Council were submitted to a meeting of the Council on Thursday last; and they showed a gratifying increase in the profits. The revenue for the year amounted to £18,423, compared with £18,145 before; and the expenditure was £12,911, against £13,529. The capital expenditure on the undertaking up to the present time was returned at £106,526; while the borrowing powers conferred by the Acts of 1893 and 1903 amounted to £122,000. The sum actually borrowed was £107,800; leaving unexercised borrowing powers to the extent of £14,200. The gross profit on the year's working was £5511, or equal to 5·4 per cent. on the capital expenditure, against £4615, or 4·7 per cent., for the preceding year. Though there had been an increase of 2 million cubic feet of gas used by private consumers, the consumption was less by 1½ million feet compared with two years ago. It was, however, pointed out that the Gas Department was slowly reviving from the effect of the competition with electric light, which is also under the Council's control. A discussion took place upon the report made that 21 million cubic feet of gas, or nearly one-fifth of the total quantity manufactured, was unaccounted for. The leakage was chiefly attributed to the heavy traction-engines damaging the mains; and a resolution was passed to the effect that Sir Alfred Thomas, M.P., be communicated with, in order that he might bring before Parliament the question of imposing a tax upon the users of these engines. The Gas Engineer and Manager (Mr. E. H. Swain) remarked that though the leakage was still very heavy, it was much less than in the preceding year. He was instructed to deal with the leakages in the most effective way that suggested itself to him.

The Bray Electricity Works.—According to a paragraph in the "Wicklow News Letter" for the 12th inst., there is a possibility of the electricity supply undertaking at Bray, which does not appear to be in a very flourishing condition, being purchased by the Alliance and Dublin Gas Company. The paragraph was as follows: "Are the Bray Electric Light Works, which have been 'Going, going' for so long, at last to be 'gone'? If rumour speaks correctly—and in this case there is little doubt it does—there seems a possibility, not to say a probability, of it. The 'very latest' is that the local Gas Company have made the substantial offer of £10,000 for them."

Oil-Gas Enrichment Company, Limited.—The Oil-Gas Enrichment Company's shareholders, at their annual meeting in Edinburgh last Tuesday, approved of the report of the Directors, the substance of which was published in the "JOURNAL" for the 8th inst. (p. 112). Thereafter an extraordinary general meeting of the Company was held, at which the Chairman (Mr. James Milne, of Edinburgh) explained the position the Company were in, and moved that it be wound up voluntarily, and that Mr. J. Gordon Mason, S.S.C., of Edinburgh, the Secretary, be appointed Liquidator. The motion was seconded by Mr. T. Craig Brown, of Selkirk, and was agreed to unanimously.

Finsbury Borough Council and the Price of Gas.—At the meeting of the Finsbury Borough Council last Thursday, Mr. Garritty brought forward the following motion: "That, in view of the new charge for meter-rents about to be imposed upon customers of the Gaslight and Coke Company, and which seriously affects the ratepayers of the borough of Finsbury, who are already called upon to pay 8d. per 1000 cubic feet in excess of what is charged by the South Metropolitan Gas Company—viz., 2s. 11d. as against 2s. 3d.—this Council do petition Parliament to institute a searching inquiry into the management of the Company, with a view to ascertaining the cause of the overcharge for gas." Consideration of the motion was adjourned on a point of procedure.

Fire at Stonehaven Gas-Works.—On Monday of last week there was considerable excitement in Stonehaven over an outbreak of fire at the gas-works. The Manager (Mr. W. Ross) and an Assistant were cleaning out a pipe in the engine-house, when escaping gas became ignited; and the flame reaching to the roof of the building set the woodwork on fire. The hose in the works was turned on the fire; but the supply of water was defective, and fishermen and others set to work to throw buckets of water on the burning material. The Burgh Fire Brigade were sent for; and when their appliances were got to work the fire was soon subdued. The Manager and his Assistant were considerably burned about their hands and faces; and damage to the amount of between £30 and £40 was done to the building.

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Electric Light Failure at Worcester.—Late last Wednesday night, Worcester was plunged partially into darkness for some hours; and it was reported that "the heavy rainfall had something to do with the trouble." The use of candles and lamps had to be resorted to in the shops and hotels; while all the classes at the Victoria Institute had to be abandoned. The centre of the city remained fully lighted, except for erratic fluctuations.

Accident while Laying a Main at Caerphilly.—A startling occurrence took place a few days ago during the laying at Caerphilly of a new gas-main by the Rhymney and Aber Valleys Gas and Water Company. The foreman fitter and two men were making a joint connecting the mains, when an on-looker dropped a lighted match into the hole in which they were working, igniting the gas and severely burning the foreman about the face. The flames, it is reported, reached to the height of the houses, and spread for some 10 or 15 yards along the road. The accident caused the whole town to be in darkness for about half-an-hour, during which time the leakage was stopped sufficiently to enable light to be restored.

Of the total quantity of coal required for the Belfast Gas-Works, for which tenders have lately been accepted, the Eveson Coal and Coke Company have booked 35,000 tons.

The Motherwell Gas Company was registered in Edinburgh last week, to take over the existing Company. The capital is £60,000, in shares of £1 each. The public are not invited to subscribe.

The Longford District Gas Company, Limited, has been registered, with a capital of £12,000, in £1 shares, to acquire and conduct the business of gas manufacturers of the Longford Gas Company, Limited, Longford, and to carry out an agreement, dated Aug. 3 last, made with Mr. Walter E. Young, the Liquidator of the Company, and Mr. Thomas Harold Benger, of Valley Road, Streatham, S.W.

Our readers will see, from an announcement in our advertisement columns, that the Maidstone Gas Company are about to make a new issue of capital, consisting of £8000 of 5 per cent. capital stock and £4000 of 3 per cent. debenture stock, which will be offered for sale at the Royal Star Hotel, Maidstone, on the 7th prox., by Messrs. Tootell and Green, in conjunction with Messrs. W. Day and Sons and Mr. Walter Cox.

Inquiries instituted by the East Preston (Worthing) Guardians have brought a notification from the Littlehampton Gas Company that the Directors are willing to supply the Workhouse and Infirmary with gas at a premium of £30 above the annual cost of the gas. The yearly £30, however, is to be reduced to £15 when the consumption in Rustington and East Preston reaches 1½ million cubic feet per annum, and the premium is to cease when the consumption shall have reached 2 millions.

The Oldham Corporation have placed an order with Messrs. Robert Dempster and Sons, Limited, of Elland, for a complete coke screening and storage plant, consisting of crane skip filling pits, with doors operated by hydraulic rams, a series of twelve overhead coke-storage hoppers and supporting structures, overhead receiving hoppers, automatic feeds to screens, four revolving screens, steam-engine and driving gear, and also radial crane gantry for feeding the screens and storing in the yard.

Last Friday, Mr. Fred. J. West, the retiring member of the Manchester City Council for Newton Heath, addressed a large meeting of ratepayers. He gave an interesting account of the work of the Rivers Committee, and said he thought his engineering experience had been of service on the Committee, of which his colleagues had elected him Deputy-Chairman. He said he was a member of a firm who paid £30,000 a year in wages; but he did not mean to imply that this money was given away. Their employees worked very hard for it, and did so under amicable, peaceful, and harmonious conditions. As an employer, he was not afraid of what anybody who was in the service of his firm might say about them. He was not a blood-sucker, but one of a firm who paid the standard rate of wages, and in many cases above it, to all persons in their employ.

The tantalizing vagaries of the electric light were well illustrated in the Court of Session at Edinburgh last Tuesday. Before mid-day the court-rooms got quite dark. An installation of electric light was introduced into the building a few years ago, and it was regarded as sufficient to cope with the gloom. It was turned on, and did all that was necessary for a little while; then it went suddenly out. The gas-fittings had been removed, and there was no help for it but to have recourse to candles. After about half-an-hour of this trying experience, the light returned, and work proceeded more smoothly; but in a little while the light failed again, and candles were once more lighted up. The second period of darkness was shorter than the first; and thereafter the light remained good. Scarcely any of the newspapers took notice of the incident. Had it been gas which had failed in its duty, there is no doubt the condemnation of it would have been universal.

A visit of inspection has been paid by the members of the Town Improvement Committee of the Gateshead Corporation to the Redheugh works of the Newcastle-on-Tyne and Gateshead Gas Company—similar to that of the Watch Committee of the Newcastle Corporation which was reported in the "JOURNAL" for the 8th inst. (p. 114). At a subsequent luncheon, Sir W. R. Plummer, proposing the toast of "The Corporation of the County Borough of Gateshead," said he had long held the opinion that there was too little intercommunication between the two boroughs of Newcastle and Gateshead. So far as the Company were concerned, they knew no distinction between the two boroughs. Their relations with the Gateshead Corporation had always been most friendly. As to municipalization, he would only say that a good many people who were members of the Corporations, and a good many who were not, held the opinion that Corporations in these days had their hands pretty well occupied, and did not suffer from lack of employment. Alderman Affleck, in reply, thanked the Directors for the opportunity that had been given to them of visiting the works, and said there had not, so long as he had been a member of the Gateshead Council, been any friction between the Council and the Company.

NOTEWORTHY

FACTS.

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No. 6.—"On Shop Lighting, with Special Reference to the Flame Arc Lamp."

This series of Leaflets will be useful, not only for distribution among Householders generally, but for circulation among Shareholders to fortify them with arguments in defence of the commodity in which they have invested capital. Copies of each Leaflet should also be kept in every Gas Undertaking's Show-Rooms.

Prices for Quantities on Application to WALTER KING, 11, BOLT COURT, FLEET STREET, E.C.

WANTED, FOR SALE, CONTRACT, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

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GAS AND WATER ENGINEER. Barry Urban District Council. Applications by Nov. 14.
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NOTICE TO ADVERTISERS.

The next number of the "JOURNAL" will contain a **FULL REPORT** of the proceedings at the Opening to-morrow (Wednesday) of the

MANCHESTER EXHIBITION

Together with Illustrated Notices of the Exhibits. It would be a convenience if Advertisers would communicate their Instructions for this Special Issue *not later than* next **SATURDAY MORNING.**

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office NOT LATER than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or stoppages of, PERMANENT ADVERTISEMENTS should be received by the FIRST POST on SATURDAY.

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